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NORTH CHINA COTTON INDUSTRY

THE NEW CANTON

ASIATIC STEEL WORKS

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THE FUTURE OF THE MOTOR LORRY

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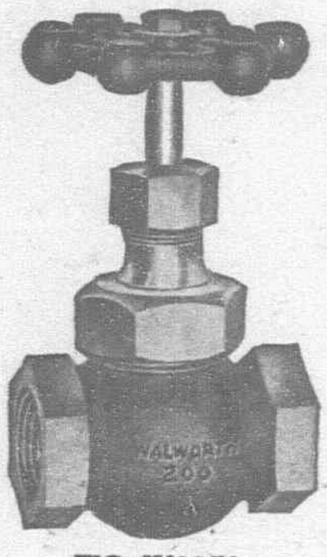

FIG. W3251
GLOBE VALVE

FIG. W3253
GLOBE CHECK VALVE

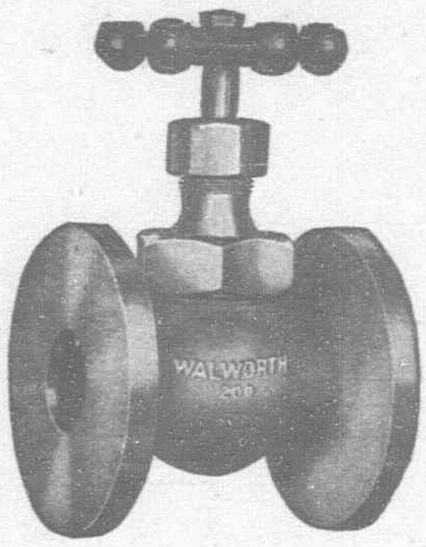

FIG. W3261
FLANGED GLOBE VALVE

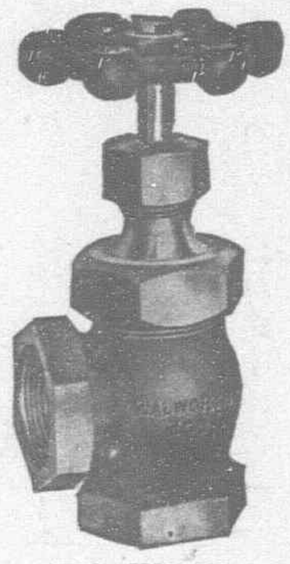

FIG. W3252
ANGLE VALVE

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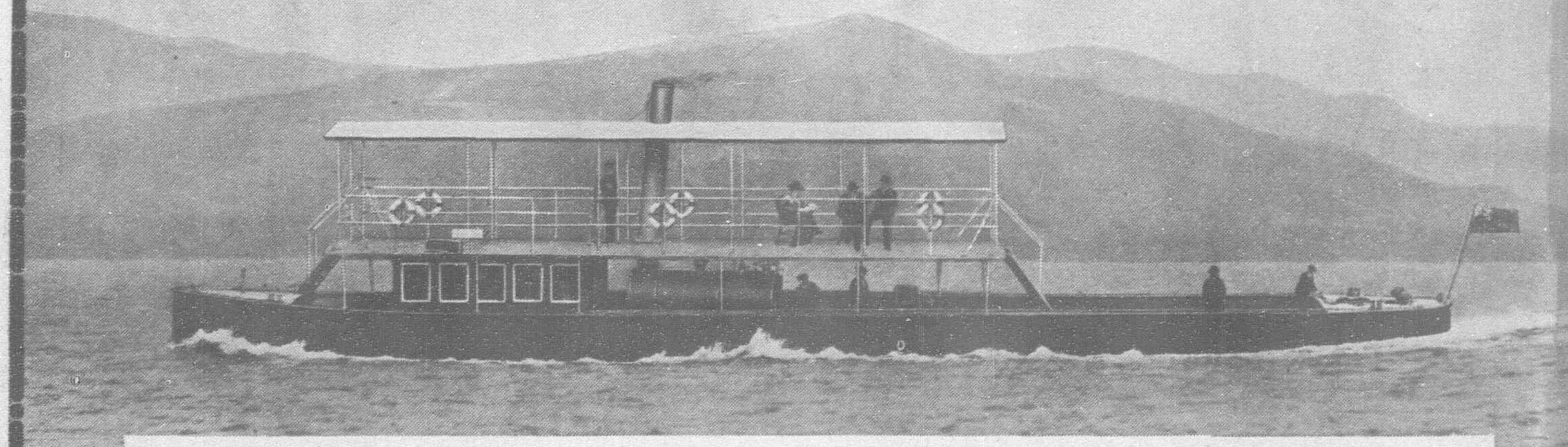

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The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XVIII SHANGHAI, MARCH, 1922 No. 3

TOKYO'S PROJECTED SUBWAY

THE TRANSPORTATION PROBLEMS OF JAPAN'S CAPITAL

Plans and Prospects of the Tokyo Underground Railway Co., Ltd.

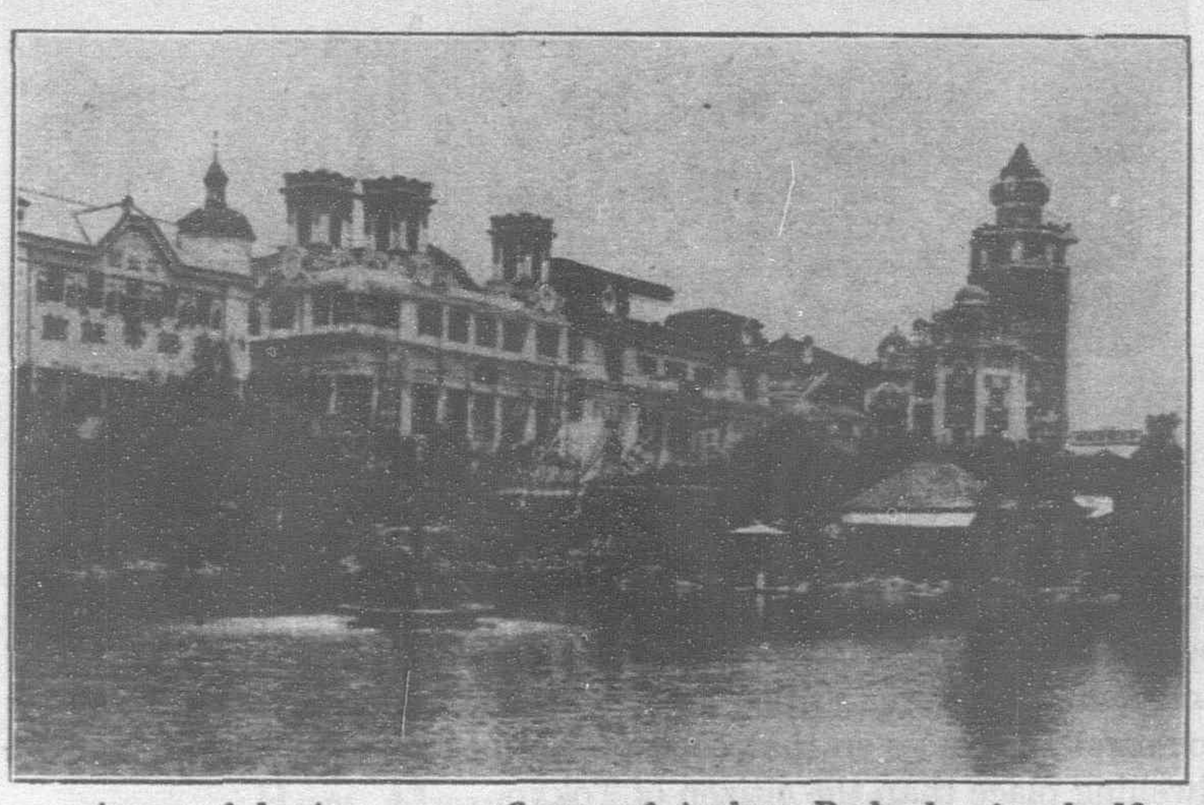
By H. C. Hugins, Professor of Economics, Keio Gijuku University, Tokyo, Japan.

TOKYO, the fourth city of the world to-day, stands in the most dire need of the immediate construction of some kind of rapid transit system which will solve its almost desperate transportation problem. The Japanese people, although they keenly feel that something is very wrong with transportation equipment in the big towns and cities, are unfortunately so geographically isolated from the developments of Europe and America, that they are slow to realize that for many years past, such systems have been in successful operation abroad, and they are slower still to demand improvements in the present ramshackle and broken-down system which no longer even make a pretence of being adequate to serve the ever-growing populations of the urban centres.

A distinction between country and city, urban and suburban, is not yet acutely drawn in Japan. Office districts and residence districts are not distinguishably separated, and business is carried on in the homes of many tens of thousands of Tokyo residents. In consequence of this lack of distinction between "up" and "down" town the greater number of persons, who crowd to the utmost limit of endurable capacity the trams of the Tokyo municipal railway bureau from morning till night, is principally made up of national and municipal officials and clerks, students, laborers and clerks in private employ, going to and coming from their day's work. Women in Japan are conventionally expected to have little to do outside their own homes, so there is little, if any, need for them to use the city tram lines to travel about in. The common people walk, and that well-to-do ride in ricshas, or automobiles. It is most noticeable that it is the middle class alone to whom the doubtful pleasure of riding in Tokyo trams is to-day almost exclusively confined. Resulting from these conditions the Tokyo municipal railway system carries only a very small part of the population of the city. In Paris the average number of rides each resident of the city makes each year is 230, in Tokyo, where population is equal to that of Paris, the average number of rides is only 113 a year.

ASAKUSA PARK. TOKYO'S GREAT PLAYGROUND, LOCATED AT THE EXTREMITY OF THE CAPITAL, ATTRACTS HUGE CROWDS DAILY; A TRANSPORTATION PROBLEM OF THE FIRST MAGNITUDE

The shopping street, where wheeled traffic is prohibited, leading to the Kwanzeon Temple in Asakusa Park



A part of the Amusement Centre of Asakusa Park, showing the 12 story pagoda

Up to a few years ago, ever with all its inadequacies of equipment, the surface transportation system in Tokyo was quite complete enough for the uses made of it by the city's population, but now, since the great growth of the city from the influx of labor with the years of war and post-war prosperity, in the Ginza district (the retail district), in Marunouchi (the new banking centre), and in Nihonbashi (the wholesale district), many large office buildings built in the past five years, attract tens of thousands of persons every day. They must all use the city's trams twice a day, at least, to carry them to and from their work. Women are now even leaving the home to take employment as clerks, and where ten years ago one woman rode on the trams in company with fifty men, to-day the number of each sex using them is almost equal. The old systems are bending under the strain of modern industrialism, systems both of transportation and society, and can no longer bear without cracking the demands made upon them.

It is no exaggeration to call the Tokyo municipal railway system hoplessly antiquated. The operation of the trams is simply atrocious: the actual condition of the trams themselves is almost beyond the ability of those who do not have to come in daily contact with them to comprehend. And with all this the whole future of the capital city of Japan, Tokyo, depends upon an immediate betterment, and extension of the present system. Even the Japanese people, so unused to consider time of any importance in their lives, are waking up to the fact that some rapid way of getting about Tokyo's streets is essential to the city's progress, and their own comfort and welfare.

Official Plans for a Greater Tokyo

Just at the present moment the Tokyo municipal authorities and a few influential citizens in close touch with official activities are loudly advocating a greater Tokyo, without any very clear idea on their part of what a greater Tokyo actually means, or what will be required to bring it about. It is not pessimism, but the teaching of the actual facts which makes it evident that a greater Tokyo is a practical impossibility unless a radical change takes place in the city's transportation systems.

The boundaries of Tokyo municipality enclose an area of 300 square miles, 837,972,000 square feet, the population of the municipality was estimated at 2,330,000 in 1921; each person in the city would have 360 square feet in which to dwell. In Paris and Berlin populations are about the same in density, but those cities buildings are from six to ten stories high, and this added space is available for dwelling places so that each person has a much greater average dwelling place than the citizen of Tokyo.

The international conference of insurance men held in 1908 expressed the opinion that it was impossible to safeguard the health of city dwellers where the space potentially available for each individual was less than 1,440 square feet. If this is taken as a standard, the population of Tokyo is living in very unhealthy surroundings indeed; while in the city's present area, it is utterly impossible to maintain the health of the present population, let alone an ever growing one. Even if Tokyo were adequately equipped with water supplied from central reservoirs, and even though a modern sewage and drainage system were installed, along with many other improvements needed to make it a thoroughly sanitary modern city, in the present limited space the municipality is crowded into, it is impossible to expect individuals to live in perfectly healthful surroundings.

The greater Tokyo plan contemplates making the district lying between Tokyo central station in Marunouchi, and Nihon Bashi (the bridge not the district called Nihonbashi), the centre of the new city which will extend outward in a circle having a radius of ten miles. This very ambitious plan has been advocated and almost adopted without any consideration having been given the city's urgent transportation needs. To go from any part of the circumference of this ambitious circle to the centre of the greater Tokyo takes, on the present tram lines, at the very least one hour and a quarter. In this day, even for a Japanese business man, to spend two hours and more a day on the trams between his office and his home is entirely too much of a good thing, and the business men know it. In this day of hustle and bustle, which has even slightly infected Japan, it is impracticable to live farther away from a city's centre than a half-an-hour's easy ride. Practically, as well as theoretically, half-an-hour is about the limit of travel a city's farthest boundary may be from its business centre.

In London, present transportation systems enable the business man to travel to his work at a speed of four to ten miles in half-an-hour. In Paris he can cover from four to eight miles in the same time. In New York the speed of trains is from four and a half to eleven miles, and in Chicago from five to seven miles in half-an-hour. In Tokyo there are no other cheap, means of getting about than those offered by the municipal surface tram lines, so that it is impossible to cover more than three and a half to four miles in half-an-hour. That is the theoretical speed of Tokyo municipal trams, but because streets are crowded with other vehicles, trams are outrageously delayed in their running times, and they are, in practice and then but seldom, able to cover more than six miles an hour. It is not difficult to conceive that a greater Tokyo with no more than the present transportation systems at its disposal will be very much of a dismal failure.

VIEWS ON THE GINZA, TOKYO'S MAIN BOULEVARD

Matsusakaya Department Store

The Ginza, looking North

Inadequacy of Surface Lines

Tokyo municipal railways to-day are in a hopelessly confused muddle, badly routed, badly operated, and crowded beyond endurance every hour of the day and night. With a population equal to that of Paris Tokyo has only 180 miles of surface lines, while in Paris there are 1.020 miles of surface lines. The difference is too great for the Japanese to contemplate with any equanimity. As overcrowding is the most visible shortcoming of the municipal service, it is popularly supposed that all that need be done to improve the service is to increase the number of trams operated regardless of the fact that the present, track, wire, and power house equipment makes any increase in the number of trams operated a physical impossibility. Theoretically the track and power equipment will operate a maximum of 12 trams on each mile of single track. Even if it were possible to increase the number of trams on each mile of track to fourteen by despatching them at intervals of 36 seconds—and it is not even suggested that this is possible—the present highest speed of eight miles an hour would automatically be lowered to seven miles an hour, and running fourteen trams a mile the system

would carry fewer passengers than the twelve trams now operated. Experience has definately proved that the equipment of the municipal railways can operate only twelve trams per mile, but this limitation applies only to the line between Shinagawa, along the Ginza, to Ueno and Asakusa Park, the main traveled line of the city. The whole city system will average only 7½ trams to a mile of single track.

On the 180 miles of track operated the greatest number of trams running at one time is theoretically 1,350. But in actual practice it is impossible to run more than 1,000 to 1,200 a day. Only a very few more trams could possibly be added to the number now run, maybe 150 to 240 could be added without absolutely disrupting the present imperfect system.

In 1909 the population of Tokyo was 1,620,000. In 1917 it had increased to 2,350,000. The average annual increase between these years was 91,000. During the same years the population of the suburbs and country districts in direct touch with the city's centre through the service of the municipal tramways, increased about 50,000 a year, making the total increase of population in and around Tokyo about 140,000 a year. In 1915, each person living in Tokyo rode on the trams 116 times. In 1918 the annual number of trips had increased to 145. The city's population is growing. while at the same time the number of rides each person takes is also increasing. It is easy to understand that the present transportation equipment of Tokyo city is absolutely out of keeping with the city's needs.

Nihonbashi Bridge, The Centre of Tokyo, looking South

At the Entrance of Uyeno Park, looking down Uyeno Broadway

Without increasing the number of transportation systems, or introducing rapid transit lines, there are theoretically five ways of making a change that will relieve the situation and benefit the city (1) by increasing the number of trams operated; (2) by building and operating longer trams; (3) by building and operating wider trams; (4) by building and operating trams with upper decks; (5) by using trailers.

But there are many difficulties in the way of laying a net work of tram lines all over Tokyo. The city streets are too narrow to accommodate tramway rails and the ordinary traffic on all Japanese streets as well. Longer trams than the new bogey type now in use cannot be handled on the narrow streets where the present lines are always turning corners very closely cut; and because the streets are narrow the gauge of the lines is narrow also, so wider trams cannot be adopted. It is not feasible to use "double-deckers" in the Tokyo streets, because of the low hanging wire equipment of the city's light and telephone services. Trailers too are impracticable because there are so many hindrances to their successful operation in the crowded streets, that their employment would be more of a detriment than an advantage to the present system. Viewed in this detailed manner it becomes apparent that it is essential that some other system than the present surface lines be put in operation if a solution of Tokyo's transportation problems is to be reached.

Motor Bus Lines

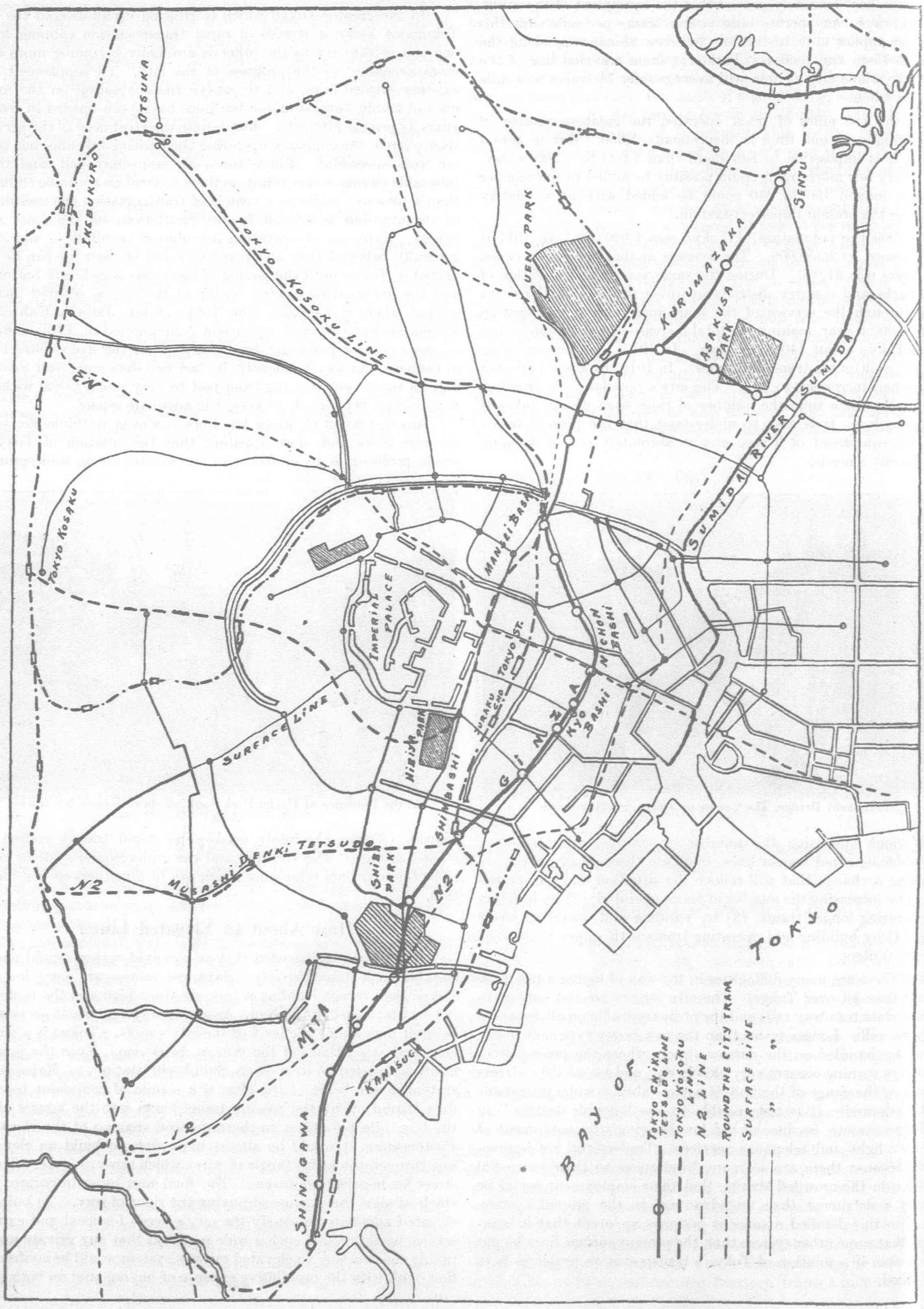
In the greater Tokyo which is growing up all around the old Tokugawa Yedo, a system of rapid transportation running from one end of the city to the other is gradually becoming more and more necessary to the progress of the city. To supplement the existing surface lines, and to relieve the congestion on the main lines of traffic, several motor bus lines have been opened in recent years by private interests. But despite the great need of the service they offered, the company operating the existing bus lines has been far from successful. Tokyo roads are uniformly bad, and their miserable paving makes riding on them more of an act to be endured than a pleasure, while as a vehicle of transportation the usefulness of the auto-bus is limited by the restrictions on their size and height. Expenses of operation are almost prohibitive, and it is generally believed that no great extension of their use can be expected in Tokyo until the paving of the roads is radically bettered, and the low-hanging electric wiring of the city is planted underground where it belongs. The Tokyo Shigai Jidosha Kabushiki Kaisha (Tokyo City and Suburban Automobile Co., Ltd.), despite its monopoly of passenger bus transport on the Tokyo streets is in rather a bad way financially, its last two dividends were passed, and its equipment is going from bad to very much worse without any attempt being made to keep it in adequate repair.

Any extension of motor bus lines is almost unthinkable, so it becomes more and more apparent that the solution of Tokyo's traffic problems is to be found in an elevated or an underground railway. Tokyo absolutely needs some rapid transit system installed at once. The elevated and the underground systems seem to be the only ones remaining which can be given serious consideration.

How About an Elevated Line?

It is generally conceded that an elevated system would not be suitable to a Japanese city. Japanese houses are very low; in Tokyo the average building is but one story high and the roofs are not very far above the ground. An elevated system would necessarily be built high above the level of the city's roofs. Tokyo is a windy city, and at all times of the year, a dusty one. Even the present limited elevated system from Shimbashi station to Manseibashi station in the heart of the city, is a source of complaint because dust stirred up by the passing trains blows into the houses along the line. People object to the noise and shaking of the elevated. Furthermore, it would be almost impossible to build an elevated line through the awful tangle of wires which crisscross every Tokyo street in hopeless confusion. The final and most important obstacle of all is the expense of buying the right of way. To build an elevated adequate to satisfy the city's needs for local and express service would require such a wide road-bed that any private undertaking constructing an elevated railway system would be confronted first of all with the prohibitive expense of buying land on both sides

ROUTE OF PROPOSED TOKYO SUBWAY



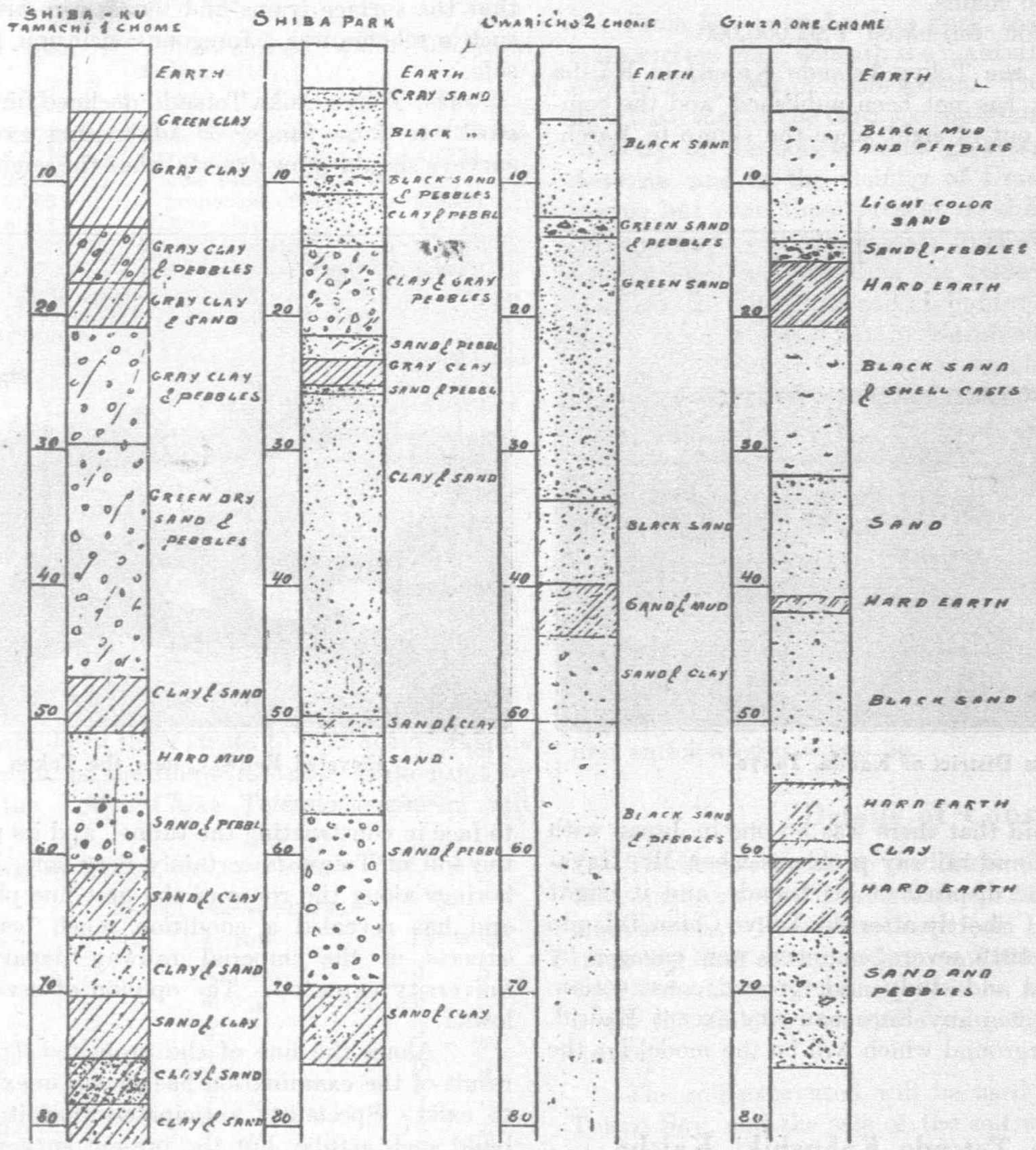
of the line traversed. The cost of the right of way would make an elevated prohibitive, and even the Y.4,000,000 a mile estimate for an underground line fades into complete insignificance before the enormous sums an elevated line would expend before an inch of the line itself could be constructed. To-day, it has become the consensus of opinion amongst traffic men that the solution of Tokyo's transportation problem lines only in an underground line. The problem of the underground has been solved by the investigations of the Tokyo Chika Tetsudo Kabushiki Kaisha (Tokyo Underground Railway Co., Ltd).

The imperial railway department, it is true, operates a short elevated line from the entrance to the city on the south, near Shimbashi station to the Tokyo central station, and thence to Manseibashi, and out towards Yotsuya and Shinjuku, in all ten miles of elevated railway. But the only part of this ten miles which can properly be called an elevated rapid transit service is that between Shimbashi and Manseibashi, 2.4 miles. The seat of the railway department's elevated lines is really only an elevated roadbed for ordinary railway traffic which was not constructed with any idea of a high speed transport service in view. Consequently they have no connection at all with the main lines of city traffic, and are of no real assistance in helping out the jumble in the city's traffic situation.

Proposed Underground Railway Systems Licensed

In 1919 a great impetus was given to all kinds of company promotion by the tremendous increase in investment funds produced by war-time prosperity, and enterprising professional promoters were not slow to hit on the scheme of building underground railways in Tokyo. Almost at the same time, one license after another was granted by the Tokyo municipality and the imperial railway bureau.

The first license to build an underground railway line in Tokyo was granted to Mr. Toshimitsu Tsurumatsu, as promoter of the Tokyo Kosoku Tetsudo Kabushiki Kaisha (Tokyo Rapid Transit Railway Co., Ltd.), then the Tokyo Tetsudo Kabushiki Kaisha (Tokyo Railway Co., Ltd.), promoted by Mr. Iida Guchi, and the Musashi Denki Tetsudo Kabushiki Kaisha, promoted by Baron Senosuke Goh, president of the Tokyo stock exchange, were issued. Since the licenses were granted, however, nothing further has been heard of these three companies. The Tokyo Chika Tetsudo Kabushiki Kaisha (Tokyo Underground Railway Co., Ltd.), promoted by Mr. T. Hayakawa, was organized in August 1920, and at once began an active survey of the route for which the license had been granted. In February 1921 a survey of the soil along the line of the first line planned to be opened was begun, and completed in September 1921. Despite the handicap of the hard times which began almost immediately after the promoters first planned the company, and which have continued ever since, the directors of the organized stock company have continued uninterruptedly to pursue the original purpose of the promoter, which was and is, to build an underground railway in Tokyo which shall relieve the present congestion on all the city's surface lines. From the very inception of the idea the Tokyo Chika Tetsudo's promoters have been fighting against almost unsurmountable difficulties. First of all, no one in Japan knew anything about underground railways, their construction and operation, and no one seemed to care much about them either. For Mr. Hayakawa, who is neither an engineer nor an ordinary promoter, wished to build a tube, not merely promote an underground railway company. Mr. Hayakawa is a man of great ability whose mind is of the constructive type. He was struck with the growing transportation needs of Tokyo as far back as 1913, and went to Europe to study the problems of transportation in great cities. His studies only tended to confirm him in a belief that the solution of Tokyo's transit problem lay in an underground system, which would act as a long-distance carrier to relieve the long haul traffic on the city's overcrowded surface lines, and which would eventually be extended to tap important outlying districts of Tokyo, particularly the suburban railway stations. Mr. Hayakawa returned to Japan in 1919, at the height of the boom, to lay the results of his investigations before certain of his acquaintances who ultimately became animated with his enthusiasm for the project. The Tokyo Chika Tetsudo is the result.



Result of Borings for Tokyo's Subway System

The routes approved for exploitation by the companies licensed are given in detail in the following table, and reference to the map will show their relation to the important centres of Tokyo city.

1. Tokyo Kosoku Tetsudo Kabushiki Kaisha.
   (Tokyo Rapid Transit Railway Co., Ltd.)
   From Otsuka to Manseibashi, Hibiya, and thence to Shinjuku.
   Total: 8 miles, 60 chains.
   Cost of construction, estimated Y.37,000,000.

2. Musashi Denki Tetsudo Kabushiki Kaisha.
   (Musashi Electric Railway Co., Ltd.)
   From Shibuya to Hibiya.

Total : 5 miles.
Cost of construction, estimated Y.20,000,000.

3. Tokyo Chika Tetsudo Kabushiki Kaisha.
(Tokyo Underground Railway Co., Ltd.)

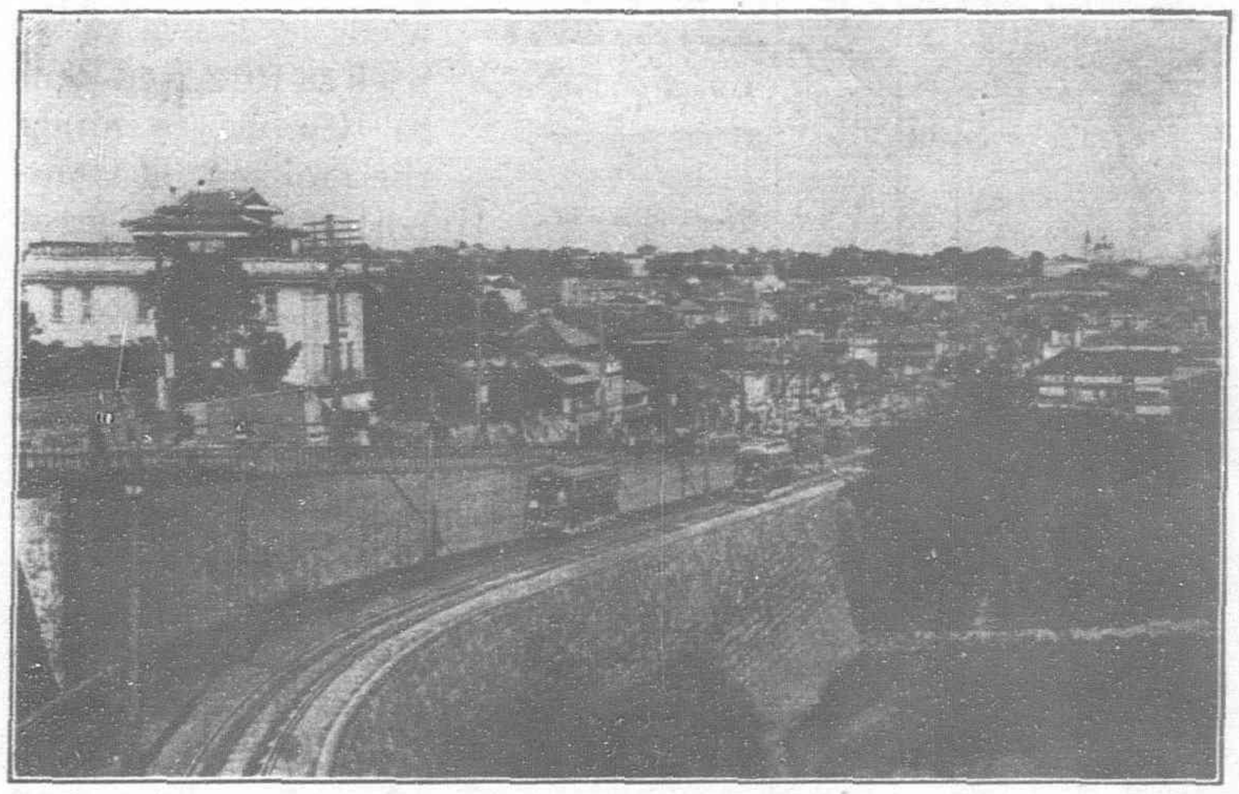
1st Line.

From Shinagawa to Shimbashi, Suda Cho, Uyeno, and Asakusa Park : thence to Minami Senju.
Total : 9.47 miles.
Cost of construction, estimated Y.40,000,000.

2nd Line.

Part 1. From Meguro to Tsukiji-Oshiage, the terminus of the Inter-urban Line, Tokyo-Chiba.
Part 2. From Ikebukuro to Takadanobaba-Iidamachi, Otemachi, and thence to Suzaki.
Part 3. Sugamo to Manseibashi.
Total : 20 miles, 60 chains.
Cost of construction, estimated Y.92,000,000.

The proposed line of the Tokyo Tetsudo Kabushiki Kaisha (Tokyo Railway Co., Ltd.), has not been published, and the company seems to have fallen out of sight since the slump in March, 1920.



The Business District of Kanda, Tokyo

It has already been said that there was no one in Japan with any knowledge of underground railway problems when Mr. Hayakawa put his ability at the disposal of his friends, and it might truthfully be said, his city. Shortly after the Tokyo Chika Tetsudo was organized privately in 1919, several engineers were engaged by the company to go abroad and study underground construction. No work was then going on in any European city except Madrid. And it is the Madrid underground which will be the model for the Tokyo tube.

The Tokyo Chika Tetsudo Kabushiki Kaisha

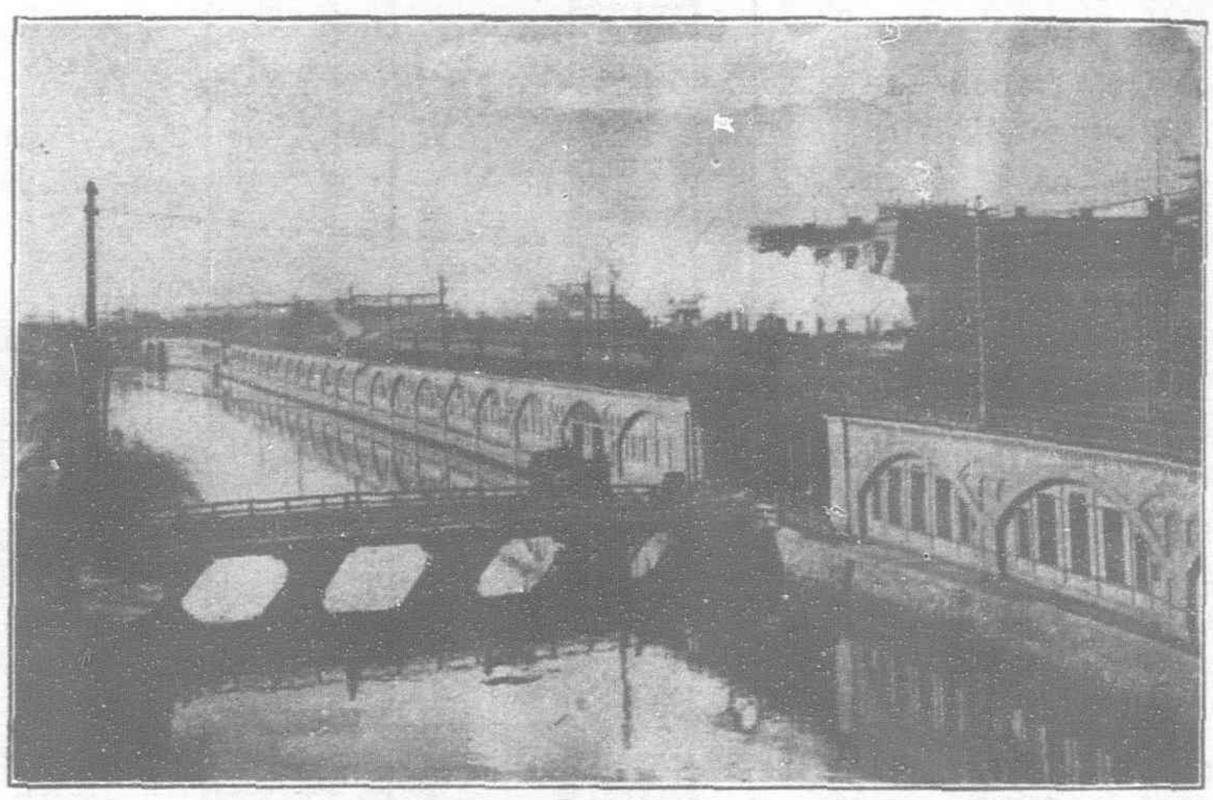
The slump which began in April 1920 effectually put a stop to any plans of soliciting public subscription for the shares of the Tokyo Chika Tetsudo. Mr. Hayakawa and his associates are all men of the highest standing and have the confidence of the whole financial world, but the panic stopped all talk of building an underground, while doubts which in the time of prosperity for company promoters were unexpressed, and which had little weight even of expression in those days, were openly entertained of the feasibility of building such a transportation system in the Tokyo "mud." It was feared that the tube would sink in the mud, or that it would be flooded by the waters of the rivers it must pass under, or earthquakes would destroy it, etc., all of which criticisms the company's promoters foundi t very difficult to answer until they had finished their preliminary survey of the soil along the route projected.

Tokyo Soil Conditions

No accurate data could be found anywhere on which to base an estimate of the engineering problems to be solved in building the proposed undergroundr ailway. The imperial railway department did have some specimen borings taken from the city's streams and canals which the present elevated system crosses, that showed a soil formation not at all complicated from an engineering standpoint. Upon these borings Mr. Hayakawa based the feasibility of his plan. Results of the detailed survey have proved the correctness of his suppositions.

When Tokyo people first heard of the underground railway plan they were much impressed with the novelty of the scheme, but when this wore off, they began to ask if the soil, the city was built on, would hold such a heavy tunnel. Wouldn't the city wake up some fine morning and find the tube sunk in the mud the city is popularly supposed to be built on ? Everyone knew that the surface trams and buses were always full, the success of such a scheme was a foregone conclusion, if it could only be made safe.

The Tokyo Chika Tetsudo declined further promotion, sales of stock, to raise funds, or advertising even, until the geological surveys should show exactly what the engineers were going to have



Elevated Railway, near the Tokyo Central Station

to face in constructing the tunnel, and its probable cost. In places the soil of Tokyo is certainly very soft, but the result of all the borings along the route of the first line planned is most satisfying and has revealed a condition much better than the geological experts of the imperial railway department and the imperial university expected. The opinion of several experts runs as follows :

" Along the line of the projected Tokyo Chika Tetsudo, the result of the examination has shown unexpectediy good conditions to exist. Specialists anticipated that it would be impossible to build such a tube, but the present survey has dissipated all their doubts. Several localities are nevertheless unsatisfactory, notably Shiba Park, the district between Satsumaparra and Kanasugi Bashi, and the district between Asakusa Park and Kikugawa Bashi. In these places the soil is weak, and it will be difficult to work in, but nevertheless it presents no insurmountable difficulties to underground railway engineers. Thus it is seen that the general opinion of the people that such an enterprise is an impossibility, is a mistaken one."

Fears that the tube might sink in the mud in soft places are unjustified by engineering experience. Pressure from below will support a tube just as the Hudson River tube is supported. The problem of construction is not a probable sinking of the tunnel, but one of accurate engineering construction which shall meet the difficulties of working in such places. The greatest difficulties the engineers will encounter will be in building the connecting links between the firm solid soil and the soft shifting mud seams which

will be encountered in Shiba, and under the rivers and canals which must be passed along the line between Shimbashi and Uyeno.

Geologists have found that the soil of Tokyo is composed as follows :

Surface to 10 feet below.—Sand with pebbles : or clay with pebbles.

10 to 20 feet below.—Clay, grey or blue or brown or yellow.

20 to 40 feet below.—Clay or sand with pebbles.

40 to 60 feet below.—Shell casts, with sand seams and pebbles.

Consequently the seam forty to fifty feet below the surface is the most desirable one in which to build the tunnel. Many persons fear inundation of the tube, but the permeation of water through clay seams will be so slight that it can be kept down to almost nothing at all by high power pumps. So this objection has also been answered.

The results of four borings made at another four places than those shown in Diagram 1, are given below :—

1. Kyobashi Ward, in front of Shimbashi Station.

Soil	Depth.
Grey sand	4.6718 feet
Green sand	3.6778 ,,
Sand mixed with pebbles	2.9820 ,,
Clay mixed with sand ...	7.7532 ,,
Green clay	6.2622 ,,
Green sand, mixed with clay	1.1928 ,,
Green clay	4.4730 ,,
Green sand mixed with Clay	2.9820 ,,
	33.9948 feet

2. Nihonbashi Ward, Nihonbashi 1 chome.

Soil	Depth.
Mud	5.2682 feet
Shell casts with pebbles	1.7882 ,,
Green clay	2.3856 ,,
Yellow clay	1.4880 ,,
Sand and clay	5.0694 ,,
	15.9994 feet

3. Nihonbashi Ward, Nihonbashi 4 chome.

Soil	Depth.
Thin black mud ...	5.6658 feet
Green sand	4.5724 ,,
Coarse sand with some properties of clay ...	1.9880 ,,
Yellow clay	2.4770 ,,
Light green clay ...	9.1448 ,,
Sand mixed with clay...	8.9460 ,,
Brown clay	5.1680 ,,
Sand mixed with clay...	2.6758 ,,
	40.6378 feet

4. Kanda Ward, Imagawa Bashi.

Soil	Depth.
Black mud	1.7892 feet
Green clay	17.9911 ,,
Sand mixed with clay ...	11.6298 ,,
Brown clay	2.8826 ,,
Sand mixed with clay ...	3.1808 ,,
Green clay	5.8646 ,,
	43.3381 feet

(*Note.*—Borings taken in cold weather).

All question of the ability of these strata to bear heavy weights is solved as a consideration of the following table worked out by actual experiment of the Tokyo Chika Tetsudo engineers will show :—

Loading Capacity of Tokyo Soil, per square foot.

At Surface	20 feet below surface.	
River bottom mud	½ ton	1½ tons
Suburban district earth ..	1 ,,	3 ,,
Clay seams (wet)	4 ,,	6 ,,
Clay seams (dry)	6 ,,	8 ,,
Sand seams	3 ,,	6 ,,
Hard Sand Seams	4 ,,	8 ,,
Sand and pebbles mixed ..	8 ,,	12 ,,
Pebbles	5 ,,	10 ,,
Clay and pebbles mixed ..	10 ,,	10 ,,

(*Note.*—Ton of 2,240-lbs. sq. foot, is Japanese sq. *shaku*, equals 0.994 sq. ft.)

The borings carried out along the line of the first tunnel planned by the Tokyo Chika Tetsudo shows that from Shinagawa to Mita (see map), the soil is composed of mixed clay and sand seams which have a very high load capacity, and gushing springs are almost entirely absent along this part of the line. This makes it possible to dig the tunnel in a space only big enough for its own tube, or, as planned, from the surface like a ditch. Either method is applicable to the conditions discovered between Shinagawa and Mita.

From Mita to Shimbashi the soil is very complicated, but for the greater part of the proposed line it is composed of sand-pebbles, and sand-clay layers. These seams are strong. From Satsumaparra to Kanasugi, however, the soil is very weak, but even along this section it is possible to build an underground without much difficulty. If the line is dug a bit away from the bay shore into Mita Ward, it will be a very simple piece of work to get from Mita to Shimbashi through soil easy to build in.

From Shimbashi to Uyeno the soil is all good. For forty to fifty feet below the surface all the strata are sand seams. Below fifty feet there are strata of pebbles, and then of hard clay. In some places there are even some seams of very soft sandstone. Along this section of the proposed line there are four rivers which must be passed. Strange to say the soil in their vicinity is especially good, and at Shimbashi, Kyobashi, and Nihonbashi, along the river bottoms there are strong compact strata of hard clay, and sandstone, excellent media for underground railway tunnel construction.

The most difficult places for underground construction are beneath river beds, but in Tokyo the soil in such places has proved exceptionally advantageous to such construction.

From Uyeno to Asakusa Park, the underground will follow the main surface lines, beneath the main street. The greater part of the way is composed of sand seams. The grain of the sand is even finer than that of the Ginz section (Shimbashi-Uyeno), and the load capacity of the soil is much greater. At Kikuya Bashi and in Asakusa, and in the vicinity of Umamichi there are some weak seams, but even these present no difficulties of construction. In these places it will be necessary to prepare the floor of the tunnel by driving piles to strengthen the tunnel foundation. Compared to Marunouchi, where the soil encountered is generally weak, Kikuya Bashi is no worse. Yet in Marunouchi they are building many fine office buildings of immense weight, and there seems to be no difficulty about their foundations. If it were necessary to drive piles along the whole line to strengthen the foundation of the tunnel the cost of construction would be prohibitive, but fortunately the first line is to be built along a route where it will be very easy to construct the tunnel.

When one speaks of the underground to-day people at once begin to talk about the prohibitive expense of such an undertaking. But in actual practice this will not be so very great. A thorough examination of the soil has shown that it is better than that of Paris or Brussels, in fact that it is very good indeed, and the construction of an underground line will be much easier than it was at first anticipated it would be.

Details of Construction

The license issued to the Tokyo Chika Tetsudo Kaisha permits the company to build the greater part of its first line just under the main streets. These streets are from 108 to 126 feet wide, including sidewalks, and as the underground tunnel will be only 24 to 27 feet wide outside, in no place will it be necessary to build the tunnel under the buildings on either side of the street, except perhaps at stations.

The soil excavated will be used for reclamation work along Tokyo Bay, and the sale of the soil will effect a great economy in the cost of construction.

The first line will have its terminals in connection with the government railway lines to Yokohama and around Tokyo city, and the Tokyo-Yokohama electric railway line at Shinagawa, and with the Oji electric tram line at Senju. The ten miles planned will actually serve in practice several tens of miles more than its own line in each direction out of Tokyo. It should, therefore, be as profitable a business in the future, as it is now a hopeful one.

The London tube is 52 feet wide, and 15 feet 9 inches wide. The Budapest tunnel is 19 feet 10 inches wide, and 9 feet high. In Madrid, the box-type tunnel is 19 feet wide, and 14 feet high, while the horseshoe type is 22 feet 9 inches wide, and 15 feet high. The Paris tube is a double track type, 23 feet wide, 14 feet 10 inches high. The underground in New York is the widest in the world, the double track line being from 27 to 29 feet wide, and the four track lines being 53 and 54 feet wide, and 13 to 15 feet high.

The Tokyo tunnel will be 17 to 18 feet high and 24 to 27 feet wide, built in the box-type, of reinforced concrete. The regulations of the imperial railway department governing the construction of underground railways prescribes a tunnel which shall be 22 feet wide, inside, and 12 feet high. The track will be broad gauge, and for this it was necessary to obtain special governmental permission. The Japanese tunnel will be smaller than the American, but larger than the British and German types. Between the tracks there will be steel supports for the roof of the tunnel. From the floor of the tunnel to the surface of the street, will be exactly 20 feet.

Cars will be 35 to 50 feet long, and built all of steel. The average speed will be about 35 miles an hour. Stops of 30 seconds will be made at the less important stations, while at important ones a whole minute will be allowed. This is the present operating system on the imperial government railways electric lines about Tokyo, not often strictly adhered to! Including time consumed in stopping at stations the average run will be 20 miles an hour. Trains will be equipped to rush into high speed on starting, thus saving time, and accordingly the run from Shinagawa to Asakusa Park, 8 miles, will be made in 25 minutes. On the present surface trams one is lucky to make it in less than an hour and a half.

The maximum gradient will be 1 in 30. The shortest radius of curves will be 300 feet, but most of them will be from 500 to 1,000 feet. Abroad trains turn in a shorter length, and the gradient is much steeper. The type of construction planned for Tokyo will make operation very simple and inexpensive. Stations will be underground so that there will be no big expenses for purchasing land to build on.

If all the soil of Tokyo were like that from Shinagawa to Mita it would be a very simple matter to construct an underground line in Tokyo. But along the Ginza where the strength of the soil is quite sufficient to hold the tunnel, there are many springs whose waters will seep into the tunnel. Just what the degree of seepage will be it is not possible to determine, but because the tunnel is built on a level it will be necessary to equip it with high power drainage pumps, which should keep the tunnel dry. Only through the pebble seams is any particular difficulty with seepage expected, but following the experience of the builders of the Berlin tube, the Tokyo engineers will use high power pumps and thus expect to ensure a safe dry tunnel.

The roof of the tunnel will be from three to six feet below the surface of the street. It is intended to build the tunnel just as though a deep trench were being dug, and the top soil will be replaced when the concrete tunnel is completed. Under the rivers tunneling will be carried on in ordinary operations, the river bottom first having been filled with cement, making the river bed above the tunnel a mere concrete ditch. This will avoid caisson work so that in no part of the line will iron tube construction be used. The route planned for the second line will take it under the Sumida River, where it will, of course, be necessary to carry on tunnelling in caissons.

Three or four years ago some sewers were dug in certain parts of Tokyo, especially in Shitaya Ward, at Ryusenji and Mikawajima. The trench was dug from 20 to 25 feet below the surface, 15 feet wide, and the height of the sewer conduit was 8 feet. The conduit was made of reinforced concrete. Certainly if this sewer could be built in poor soil, the Tokyo Chika Tetsudo tunnel which will be a double line tunnel, with an outside width of 25 feet, and height of 17 to 19 feet, can easily be built even in bad soil. Stations, of course, will require larger spaces, but they need be only 12 to 13 feet high.

There are many lines of water mains and gas pipes laid beneath the surface of Tokyo streets. Generally they are only 2 to 3 feet below the surface, although in some places they lie as low as 5 to 6 feet underground. Compared to the depths at which such pipes are laid in many foreign countries, this is not exactly deep.

In two places on the Ginza which the main line will follow there are 7 such pipe lines now laid. Water mains 20 and 30 inches in diameter, gas mains 6 inches and more in diameter, and some sewer pipes 12 and 14 inches in diameter, and a few instruments of the Tokyo municipal railways and the Tokyo Dento Co. (Tokyo Electric Light Co.), are also buried under ground. From the Ginza to Uyeno the main street is 90 feet wide, exclusive of sidewalks. The outside width of the underground tunnel will be 27 feet, so that it can easily be built under less than half the width of the street above. So owners of buildings on the surface above the underground line need entertain no anxieties about the foundations of their property. Only at the stations will the line be crowded out under the space occupied by the surface tram lines. Tokyo is not overly well equipped with pavements and light and power wire carrying poles, so the company will be put to little expense for tearing up and replacing expensive improvements. When the underground is completed all the gas, and water mains, and sewer lines will be buried again in a conduit which will hold them all.

Cost of the Underground

If there are no unexpected engineering difficulties encountered in constructing the Tokyo underground, and if the soil is no different from that revealed by the tests already made, estimates of the outside cost of the first line between Shinagawa and Asakusa to Senju are Y.4,000,000 a mile. Four million yen a mile will cover the cost of the tunnel, all railway equipment, passenger stations, power transmission stations, automatic safety devices, in fact everything of the very latest efficiency to ensure the successful operation of such a railroad. The Tokyo municipal bureau of construction and the municipal railway bureau are agreed that Y.4,000,000 a mile will cover all the necessary expenses of construction and equipment. If Y.4,000,000 is the maximum cost per mile, then the nine miles and forty chains which are planned between Shinagawa and Asakusa will require Y.38,000,000. The Tokyo Chika K.K. directors estimate that the actual cost of putting the line in operation will actually be about Y.3,000,000 less than this. But any difference in estimates makes no particular difference to-day, the whole question now is, Will the road prove profitable?

It will require at least Y.4,000,000 capital paid up in full to put the underground in operation. Assuming interest or dividends at 8 per cent. a year, the company must earn Y.3,200,000 net profit annually in order to interest capital in its shares. Certain sums must also be set aside annually for depreciation and maintenance of equipment, and there are also the usual reserves, bonuses and the dividend equalization fund, so important for all Japanese industrial enterprises. Including all these funds the company must earn at least 12 or 13 per cent. a year net, about Y.5,200,000.

There will naturally be two sources of revenue, passenger and freight traffic. But although freight traffic should be extensive, it is not calculated on to yield one sen of revenue in the estimates which the promoters have made of probable earnings. The Tokyo municipal railway's lines from Shinagawa to Uyeno and to Asakusa, and then on to Kurumazaka, and Senju-Ohashi (see map), are to be followed, more or less, by the Chika Tetsudo tube, and the income for these lines on the surface is publicly known, so that it will serve for making an estimate of the probable passenger traffic and income of the underground.

Assuming that the income of the underground will reach a third of that of the surface lines, that third would be at least Y.6,673,000 a year.

On September 1, 1916, there were 42 stations on the municipal surface lines between Shinagawa and Asakusa, and that day 334,300 passengers were carried between the two terminals, while all the lines in the city carried 908,848 passengers the same day. From these figures it can be seen that 36.8 per cent. of all the passengers carried in that city that day rode between Shinagawa and Asakusa.

Between September 1, 1920, and August 31, 1921, the whole number of passengers riding on the municipal surface lines was 424,050,844. If we assume the percentage shown in 1916 for the traffic on the Shinagawa-Asakusa line still to be good, in the 1920-1921 fiscal year between the terminals alone, 156,050,710 passengers were carried. The increase in passenger traffic is about 10 per cent. a year, and on the basis of the figures given it becomes possible to estimate that in 1921-1922 fiscal year, 171,655,781 persons, in 1922-23 fiscal year, 188,821,395 persons, and in 1923-1923 fiscal year, 207,703,495 persons will travel on this important main line through Tokyo's busy streets.

If in 1923-24 one-third of these passengers should ride in the underground 69,234,498 fares will be paid. The tube will be opened in 1924, so we need not consider passenger conditions before that year in any estimate of the income of the Tokyo Chika Tetsudo. Consequently it is not a far stretch of the possibilities to estimate that the Shinagawa-Asakusa underground railway line will carry at least 69,200 passengers in the first year of operations.

Fares paid have been estimated at an average of 9.6 sen per person. The basis of the estimate is the ideal of charging the same fare for a long or a short ride. If a special charge is made for long rides, then perhaps 8 sen will be charged for the short ride. But this will make little difference in the estimates of total income. There is some talk of dividing the line into zones, but this would be a great mistake. The real utility of the underground line will be for long rides, not for short ones, and if it is efficiently operated it should absorb all the long-distance traffic now crowding the surface lines. Therefore the distance between stations will not be too short.

The lowest fare charged will probably be ten sen for a ride of half the distance. Full fare for the whole line will be 20 sen. If the line is divided into fare zones, it will probably not increase income. If a different charge is made for the long and the short hauls, it is very difficult to estimate income. But if income is estimated at a uniform fare of ten sen for all rides, then total income for the first year will be Y.6,920,000. This is Y.240,000 more than the company's estimate, and actually the result will probably be even better than this estimate. The line from Kurumazaka to Senju is not included in this estimate.

The Tokyo Chika Tetsudo Co. estimates annual cost of operation and upkeep at Y.1,536,000. Of this amount Y.273,750 represents power cost, based on a consumption of 25,000 kilowatts a day, at 3 sen a kilowatt. Other traffic expenses are estimated at Y.297,660: Office expenses, etc., at Y.149,000. Other operating costs :—

Carriage upkeep	Y.61,000
Track upkeep	20,000
Wire upkeep	8,500
Building repairs	15,000
Taxes	55,000
Operation of transformer stations	11,500
Miscellaneous expenses	15,000

The cost of power will, of course, vary with the number of trains operated, and the number of passengers carried. All other expenses, if compared to those of other companies, show that they have been adequately provided for.

The estimates for carriage and track upkeep at Y.90,000 may seem insufficient, but if the total expenditure is raised from Y.1,530,000 to Y.1,560,000 a year a discrepancy if any can easily be met. If income is Y.6,940,000, and expenses Y.1,560,000, net profits will be Y.5,400,000. It has been estimated that from Y.4,800,000 to Y.5,200,000 will be needed to pay a dividend of 8 to 9 per cent., but it can be seen the figures given here provide for Y.200,000 to Y.6,000 in excess of the needs of the company. If expenses are increased Y.100,000 a year over the company's estimates this will still leave a net income of Y.5,320,000. If this turns out to be the case the ratio of profit to paid-up capital will be 13.3 per cent., and an eight per cent. dividend will be easy to pay. All estimates have been prepared so that in actual practice there can be some contraction if necessary, and this makes the promoter's estimates more worthy of confidence.

It is conceded that an estimate that passengers will be only one-third of the number now carried on the surface line is too low. Experience abroad with undergrounds has been that the underground carries from 2½ to 14 times the number of passengers riding on the surface lines. Assuming the number of passengers in the Tokyo underground in 1926 to be one-half as great as the number using the surface line, the result would be (leaving out of all calculations the Kurumazaka-Senju line), 103,851,500 passengers. Paying 10 sen fares the total income of the company would be Y.10,385,000. If profits are figured to increase Y.2,000,000 in the same year, and paid-up capital is Y.40,000,000, then net profits would be about 20 per cent. If passengers reach the numbers estimated the cost of Y.4,000,000 a mile will be very little compared to the results that will be financially achieved.

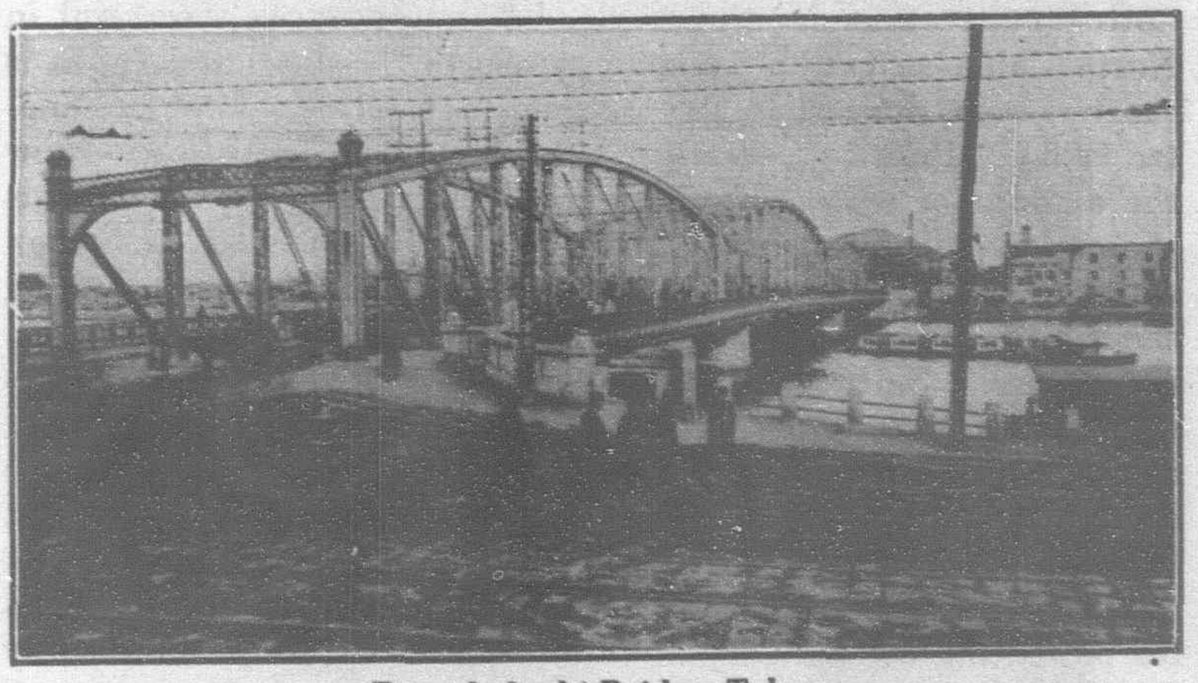
The average city tram fare is 6.88 sen. If the underground carries only 103,000,000 passengers at this fare, its earnings would be Y.7,155,000, and net profits Y.5,150,000, a profit rate of 12.8 per cent. All the shareholders expect is an 8 per cent. dividend, and there will be no difficulty whatever in earning enough and more than enough to pay it.

The Tokyo Chika Tetsudo Kabushiki Kaisha was organized at the time of the business boom with an authorized capital of Y.40,000,000. The panic caused the promoters to decrease this to Y.10,000,000, but only Y.1,000,000 was ever paid up. With this money the preliminary surveys were undertaken, and now that they have proved so successful the balance will soon be called up.

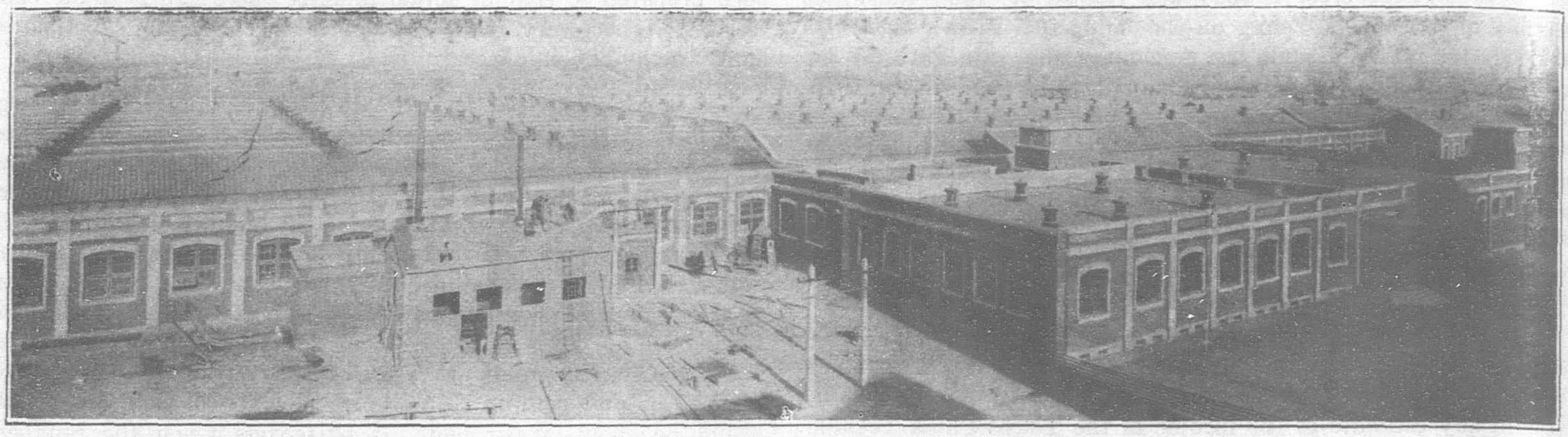
It should not be difficult to raise the balance of the Y.30,000,000 needed. But if this proves impossible in Japan, foreign investors will be asked to co-operate with the Japanese promoters. It is conceded that Japanese investment conservatism is doing a great deal to retard the building of the underground, financiers having no experience in such enterprises to guide them, and consequently they doubt all the estimates, and the feasibility of the project.

It is said that American financiers are looking over the field, and that they are much impressed with the findings of the Tokyo Chika surveys. Furthermore it has recently been reported from London that British financiers will co-operate with the group which has been licensed under the name of the Musashi Denki Tetsudo under the leadership of Baron Goh. But as this concern has not made one step to investigate the soil along its proposed route, the Tokyo Chika Tetsudo is the first in the field.

The complete geological survey was completed in September 1921, and ever since the plans for construction have been in preparation. It is now reported that actual construction will be begin in February or March of this year. The other companies have not yet got beyond the stage of plans to do something later.



Ryogokubashi Bridge, Tokyo



A Modern Textile Plant in North China; The New Heng Yuen Textile Company's Mill at Tientsin, equipped throughout with American Machinery

North China Cotton Industry

THE rapid development of the Chinese cotton industry during the last two decades has caused surprise in China and other countries. During or before the so-called "Boxer Rebellion," in 1900, the cotton spinning industry was not understood by the people in North China, and cotton growing was known only to a very limited number, says Mr. Ben Y. Lee, of Tientsin, in the *Textile Mercury*. But to-day millions of pounds of cotton are being produced annually and millions of *mows* of land are under cotton cultivation. Tientsin is the great cotton mill and cotton distributing centre in the north of China, and ranks second in China, next to Shanghai, as a great cotton manufacturing centre and is a new field for this industry. If conditions remain favorable as at the present time, in a few years to come this city will have a half million spindles and thousands of looms. The business opportunities of the city are based on the fact that it is the outlet for a vast hinterland consisting of the richest provinces of North China, and extending into Mongolia. Its good communications by land, rail and water have made it a distributing centre for a constantly growing volume of imports and exports. It is the great distributing point in the north of foreign goods as well as a collecting depôt for goods to be shipped abroad. Animal products and cotton form its chief exports.

Almost all cotton grown in the north provinces is being shipped to Tientsin. Some is being exported to Japan, where it is used for stuffing kimonos and other garments, and also to the United States, where it is mixed with wool in the manufacturing of blankets. Owing to the fact that it is well adapted to the latter purpose, the United States is one of the best purchasers of this grade of cotton. Cotton cultivation, on the whole, has not been so successful in North China as in the Yangtze provinces, because the season is shorter, frosts are earlier, and the soil is not so rich as that in Yangtze valley. Prior to 1900, there are no available statistics to show the amount of cotton in this region. In 1902, however, records show that there was more than 70,000-lb. exported to foreign countries, especially to Japan, and to other ports in China. During the last twenty years cotton exported from Tientsin has been grown enormously. Since 1910, the annual export from Tientsin has varied from 50 to 100 million lbs. Factors which have stimulated cotton production are the substitution of the cotton plant for the opium cultivation which had been prohibited by the government; the organizing of the Chinese millowners' association; the bureau for the improvement of the cotton industries; and organizations for promoting the industry in various places by establishing many cotton experimental stations; a better demand from abroad, especially from Japan; the successful efforts of the dealers to stop the practice of watering the cotton; and lastly the high price of cotton during the past few years.

The following table gives the amount of cotton grown and the amount of land used for cultivation of cotton in the northern provinces and also others. In the northern provinces are included Chihli, Shantung, Shansi, Shensi and Honan. The word "*mow*" in Chinese means about one-sixth of an acre, and *picul* about 133-lb. :—

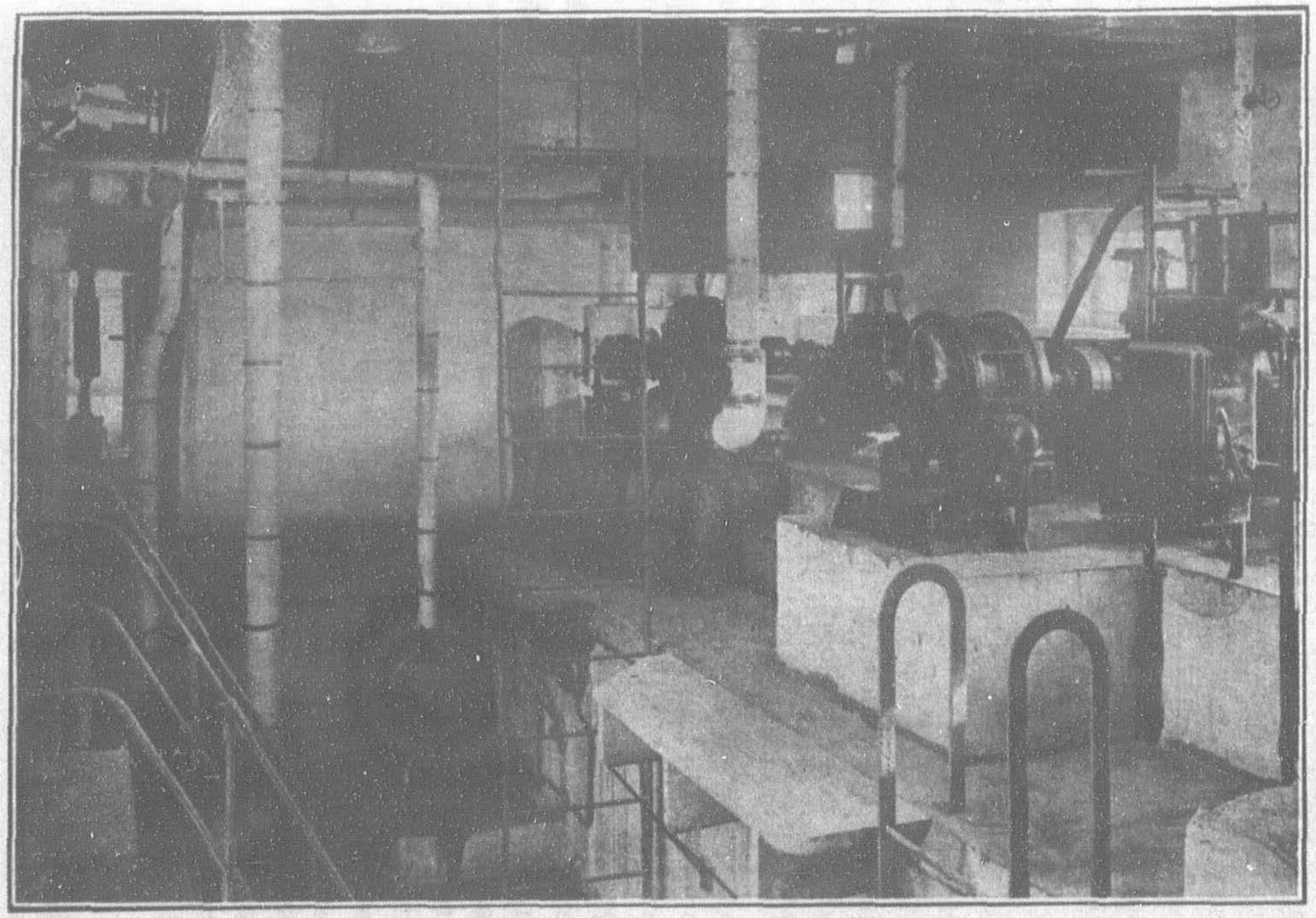
	1918. Piculs.	1919. Piculs.	1919. Mows.
Chili	2,099,381	4,794,083	6,104,349
Shantung	720,787	3,429,610	3,873,500
Shansi	304,322	99,370	490,000
Shensi	680,000	720,000	—
Honan	268,161	2,746,620	2,531,600
Hupeh	2,370,000	4,300,000	3,971,342
Kiangsu	3,368,500	4,128,500	8,890,000
Chekiang	724,000	743,000	1,638,000
Hunan	—	78,150	73,420
Kiangsi	131,250	16,900	16,400
Szechuan	—	—	—
Anhwei	243,000	125,530	—
Total	10,022,700	19,577,000	27,500,000

The foregoing table has been compiled and tabulated recently by the bureau for the improvement of the cotton industries, Tientsin. The statistics given by the Chinese millowners' association, Shanghai, in regard to the production in 1919, is 4 million bales of 500-lb. each. The difference is due chiefly to the incorrect reports and incomplete investigations of both associations and also the inaccessibility of certain parts of the country. Cotton grown in many localities is being consumed locally, hence absolute accuracy is almost impossible. It will readily be seen that Chili province, in which Tientsin is located, is becoming a great cotton-producing centre. The following table gives the percentage of cotton grown in various provinces, and the numbers are for the reference to the chart :—

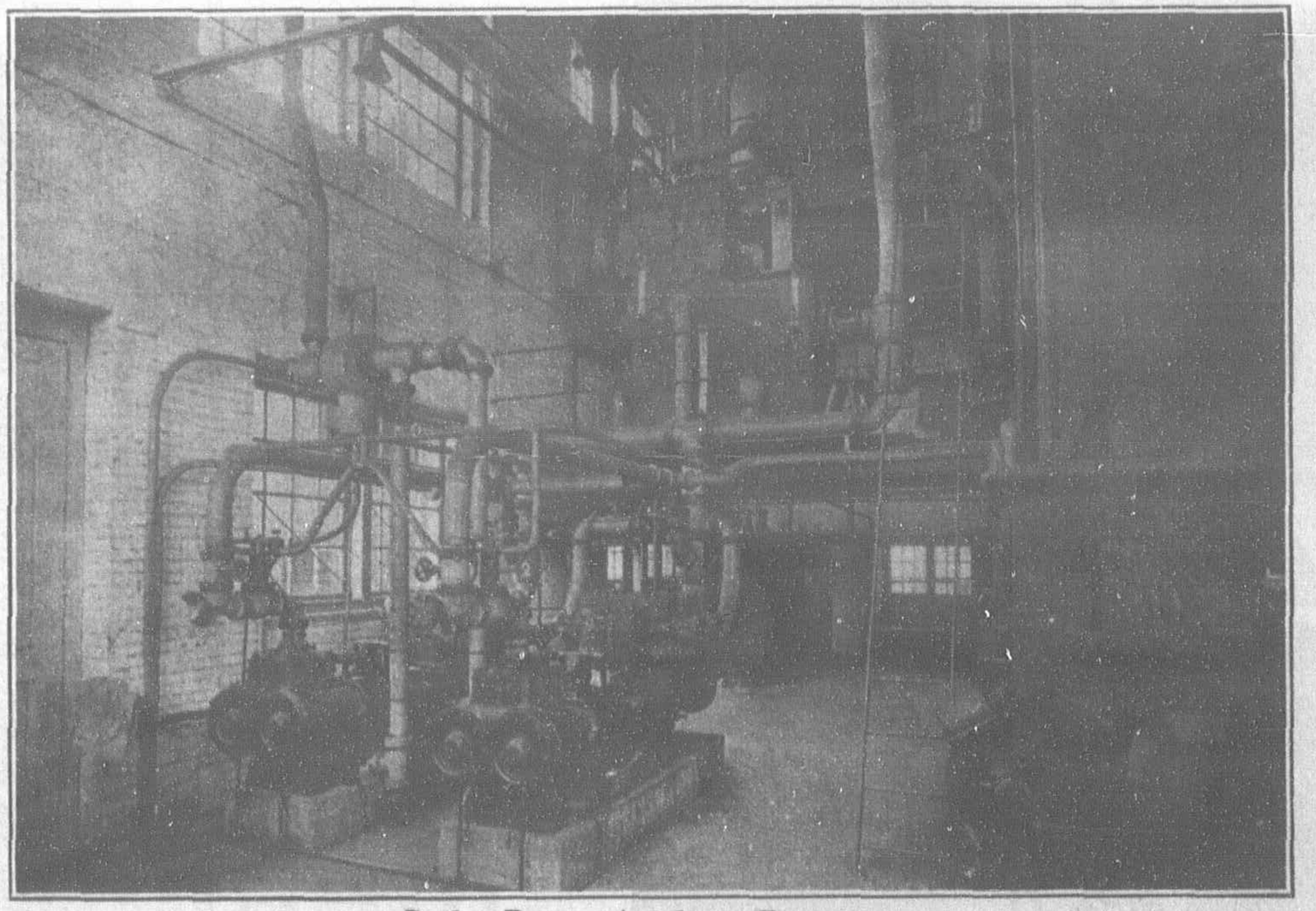
	1918.	1919.		1918.	1919.
Kiangsu ..	35.70	21.00	Honan ..	2.63	14
Hupeh ..	20.41	21.60	Anhwei ..	2.10	0.6
Chili ..	18.15	23.00	Kiangsi ..	0.91	0.10
Shantung ..	6.23	17.00	Shensi ..	5.19	0.37
Shansi ..	2.32	0.5	Chekiang ..	6.26	3.80

The average length of fibres grown in the North is about 1-6th to 1-8th of an inch, and some are of nearly an inch. It can be spun

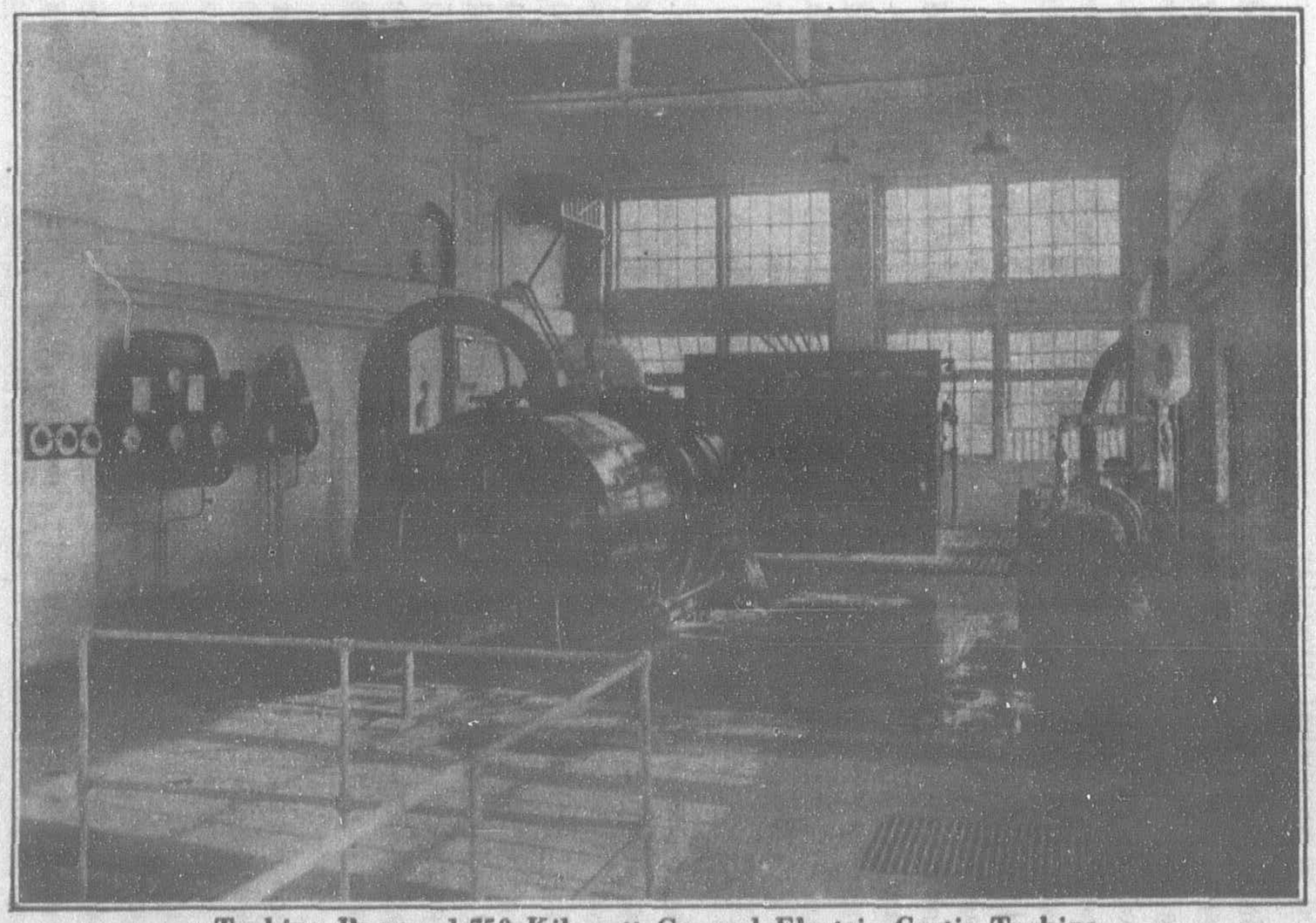
POWER EQUIPMENT IN THE HENG YUEN TEXTILE MILL AT TIENTSIN



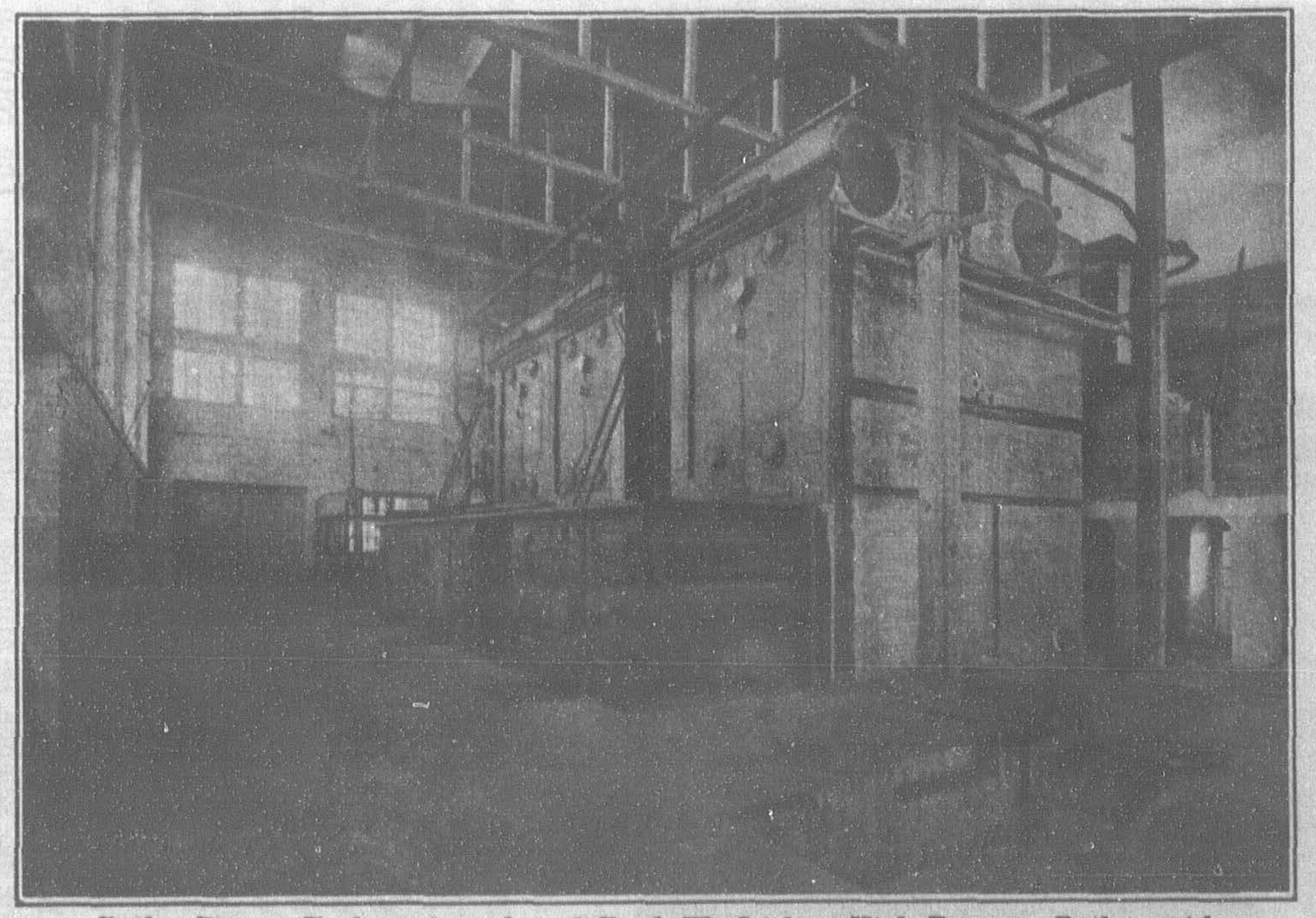
Circulating Water and Hot Well Pumps



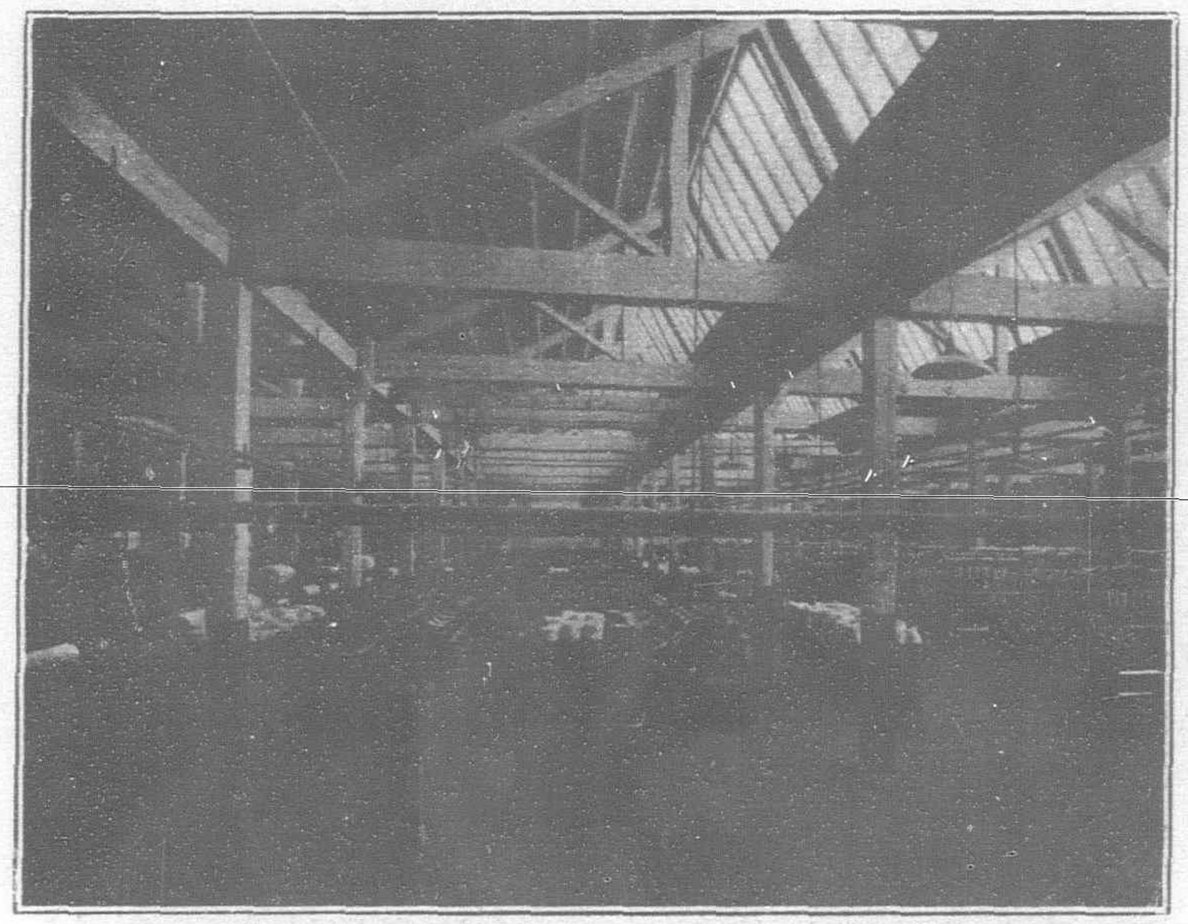
Boiler Room—Auxiliary Equipment



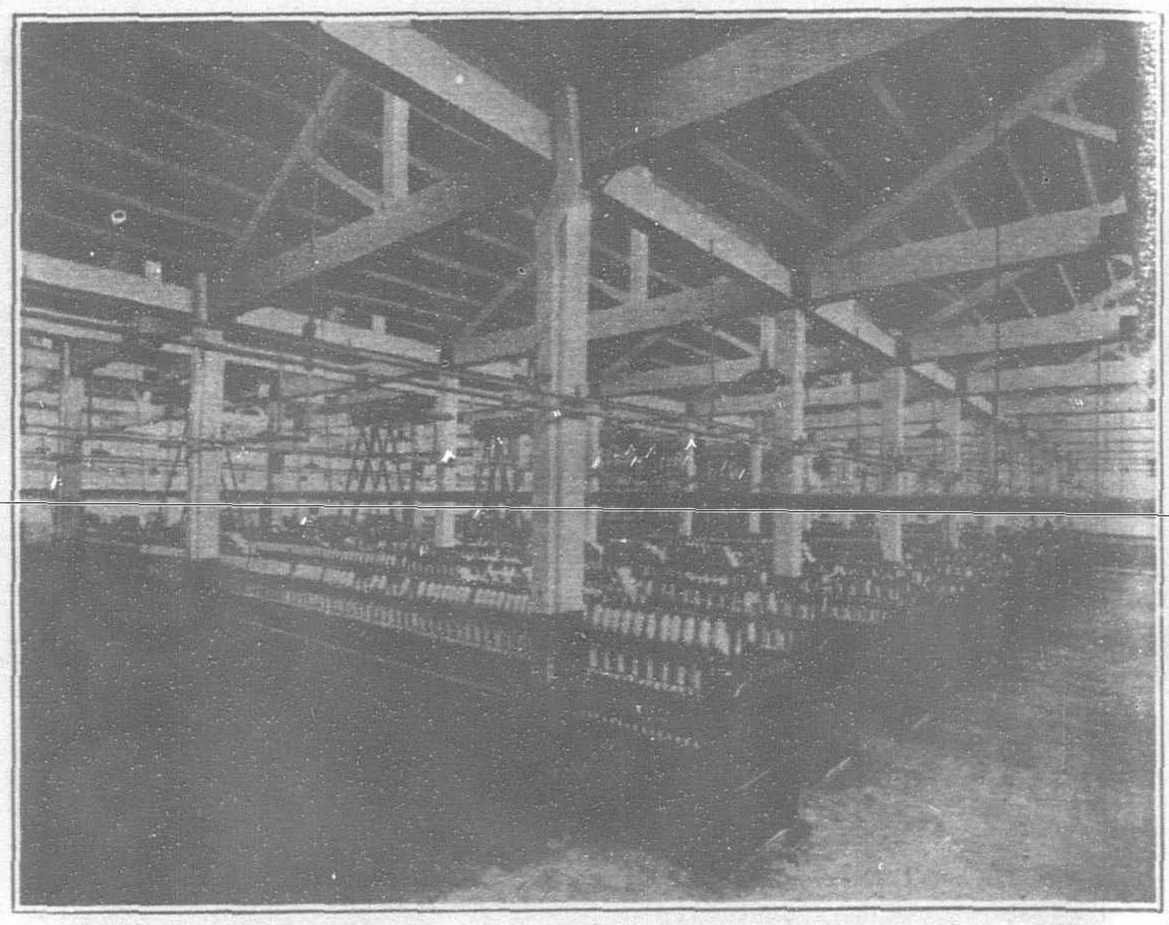
Turbine Room: 1-750 Kilowatt General Electric Curtis Turbine



Boiler Room—To be enlarged to 5 B. & W. Stirling High Pressure Boilers with Murphy Stokers and Diamond Soot Blowers



Section Card Room, Saco Lowell Textile Machinery, American Moistening Co.'s Humidifier System



Spinning Room: General Electric Motors used throughout Mill

up to 36's. The staple most nearly resembles Peruvian cotton and is of fairly good color, but is wiry. The above is from native seeds. Many tons of American seed are now being distributed free to the farmers living in the neighborhood of the various government experimental stations. Almost all these stations have finally decided upon "Trice" as the best early variety of American cotton for extensive cultivation. Next to "Trice" is "Lone Star," then "Cook's Big Boll" and finally "Banker's Account."

Modern farm implements are not yet employed, because of the lack of modern improvements and the narrowness of the Chinese cotton field. The average field is less than half an acre in width. Man labor is employed chiefly on account of the low rate of wages. Little or no science is applied in the cultivation. The rotation adopted is somewhat irregular.

Planting begins in the early part of May. Seeds are scattered all over the field instead of being distributed in rows. Thinning usually takes place about a month after seeding. Picking begins in October until before the frosts. Two kinds of fertilisers are used. The one which is used extensively is the "home product," and the other is the cotton seed cake and bean cakes. The former may be applied to the soil either before or after, or during the cotton season. It consists of human excreta diluted with about 50 per cent. water. It is distributed over the fields by hand with the aid of long handled ladle, and is spread over the surface of the soil. This kind of fertiliser may be purchased at very cheap prices. The cotton seed cake and bean cake are broken into pieces about half-an-inch square and then are put into the cotton bed near the root of the cotton by hand at about one-quarter of an inch deep.

The exact cost a *mow* of producing cotton is difficult to ascertain, for nearly all the cotton growers cultivate a few *mows* of land by themselves without hiring any help. Some farmers managing large farms generally hire help, and pay from 30 to 70 dollars per year, with food and shelter free; while others pay from 4 to 10 dollars for picking for one season only. Each *mow* of land can produce from 60 to 150-lb. of seed cotton, of which 30 to 35 per cent. is lint cotton. The price of lint cotton in this region since the new year is from 21 to 23 taels per picul. Nearly all the growers do not buy seeds; they select the good quality from year to year. On account of lack of intelligence and technical education, most farmers cannot manage farming on a large scale.

The cotton gins employed are similar in appearance, principle and operation to the "Macarthy" gins. Nearly every farmer of some means owns one, and gins his cotton before selling it. The weight of these ginning machines is from 70 to 100-lb., and they are manufactured both in Japan and in China. They can either be moved by steam or man power. The total amount of cotton produced by one of these machines in a working day of eleven hours is from 150 to 200-lb. The seed cotton is fed by hand to the table in the front of the machine, and, falling into the hopper, is brought into contact with the revolving roller. After being passed through many mechanical devices, the ginned cotton is stripped from the roller by the stripping beard. It falls to the ground in a continuous fleece, and is kept from mixing with the seeds by a sheet iron division plate.

After ginning, the cotton is packed in bags either made of coarse grey cloth or made of bamboo strips. The sizes of these bars vary, some being 84 to 46 inches, some 72 by 42 inches, and others 48 by 36 inches. The weights of these bags are various, from 300 to 100-lb. Cotton is either transported by boats or by railway; the transportation cost varies from 60 cents to one dollar per picul. Many foreign firms and their representatives to the interior to buy small quantities from individual farmers, and then ship large quantities at a time by special boats. A Japanese firm named Mitsui & Co. is doing a large business of this kind.

The increase in the number of spinning mills in these provinces has been developed in proportion with that of cotton growing. Before 1914 there was not a single cotton spinning mill in the north, but now there are more than a dozen scattered over these provinces. The following table gives the number of mills in Tientsin and its neighborhood including those under construction and planning:—

Name of Mill	Year est.	No. of spindles	Maker	No. of looms
Heng Yuen (old unit)	1914	5,000	H. & B. English	
Heng Yuen (new unit)	1920	20,000	Saco Lowell	300 (C. & K.)
Yu Yuen	1918/21	70,000	Saco Lowell	500 (C. & K.)
Wash Sing No. 1 ..	1918	20,000	Saco Lowell	
Yu Ta (under construction) ..		35,000	Saco Lowell	
Pao Cheng No. 3 (under construction)		50,000	Saco Lowell	
Pei Yang No. 1 ..	1921	25,000	Saco Lowell	
Wei Yu (Proposed)..		20,000	Saco Lowell	
Model Mill (under construction) ..		10,000	Fales & Jenks	

It is reported that Japanese capitalists have proposed three mills of from 20,000 to 30,000 spindles each to be located at Tientsin, but so far none of them have been materialized.

The following table gives the number of mills in other northern provinces :—

Mukden Mill (under construction) ..		10,000	Saco Lowell	300 (C. & K.)
Lu Foong, Mukden				
Tsinan, Shantung	1918	15,000	H. &. B. English	
Wah Sing No. 2				
Tsinan, Shantung	1920	15,000	Within	
Wah Sing No. 3				
Tangshan, Chili		12,000	Hetherington	

There are also several proposed new mills ranging from 10,000 to 15,000 spindles, to be located in Shensi and Honan provinces. The makers of the machinery are both British and American. It is also reported that there are many Japanese mills to be operated in Tsingtao, Shantung.

Nearly every cotton mill in the North, under Chinese management, especially those in Tientsin, is or has been financed and promoted by high or ex-officials. In many Tientsin mills the big shareholders are not well known in public. Pei Yang, a mill in Tientsin, is the only exception to the general rule, that is financed entirely by the Chinese yarn dealers in the city. The wages and salaries paid in all the mills in the North are about 10 per cent. higher than those in Shanghai and elsewhere.

The Yu Yuan Textile Company of Tientsin is the most prosperous. The mill was organized and constructed in 1917, and was under operation in 1918 with 25,000 spindles. The promotors are high officials, and the mill has been financed by a few men. During the last three years enormous profit has been made, and with this the second extension of 25,000 spindles was made in 1920, and a third extension of 20,000 more spindles and 500 looms will be made in 1921. Thus with a total of 70,000 spindles and 500 looms, it becomes the largest mill under the same management in the North, and one of the largest Chinese mills in the empire. Among the factors that have contributed to its success are honesty and efficiency on the part of the manager, together with good systems of bookkeeping, recording of production, and laborers, etc. The mill employs practically all young men, called apprentices, from 12 years old and upwards, with a few women operatives. Lodging and food are provided free to the apprentices' and mechanics' families. The tenement rooms are built of one story near the mill for all operatives. The daily production per spindle for 16's yarn for so-called 24 hours is over 1-lb., and for 10's nearly 2-lb. On the average the percentage is from 5 to 10 higher than other Chinese mills. The breaking strength of 16's yarns is nearly 90, and of 10's is over 110-lb. These two things have made the mill successful in the manufacturing end. Roving, draw frame and spinning frame operatives are paid by hanks. In average Chinese mills there are about 650 employees per 10,000 spindles for both day and night shifts, but this mill employs 5 to 10 per cent. less. In other mills many small children, not tall enough to reach the front roll of spinning frames, are employed ; in this mill not a single person under 12 years of age are employed. Dining halls are provided for operatives outside the mill proper. Such things are rarely seen elsewhere in China.

The manager being instilled with modern education is doing much philanthropic work for his employees. The welfare features for the employees have been developed. Pool room, mill school, lecturing system, reading room, library, etc., are provided. Such a spirit is rarely found in Chinese mills. Nearly every operative has been receiving a bonus twice a year of from 10 to 150 dollars each. Every salaried man has been receiving more than 200 per cent. bonus monthly besides some "extra" during the past years. The manager himself has been receiving, including salary and bonus, more than the president of the United States receives annually. The shareholders have been receiving over 30 per cent. dividends besides the additional shares for the new additions. Perhaps within a few years the mill will become the largest one in China.

The question of supply and demand of cotton for local consumption in the north is important as well as interesting. Taken as a whole, China has up to the present time about 2,000,000 spindles, more than 1,500,000 of which are located in Shanghai or in its neighborhood. In the northern provinces there are about 300,000 spindles, including those under construction and proposed, or, in other words, there are about 15 per cent. of the total spindles located in the north. Yet the northern provinces produced last year a little over 50 per cent. of the cotton grown in China, and it is expected a greater percentage will be produced in consecutive years. One great and distinct advantage that the northern mills have is the abundant and ample supply of raw cotton. At the present time the larger part of the cotton grown in the north is being exported to Shanghai or to foreign countries. On the average each spindle consumes about two and a half piculs per annum, then 300,000 spindles would consume at the most 750,000 piculs per annum. It is clearly seen that the question of shortage of supply of cotton for the northern mills does not enter into any serious consideration. The high price of cotton yarn and raw cotton during the year 1920 up to the present time, which materially aided in the rapid development of the cotton mill industry in China, rhould also be taken into consideration. The prices of these had seached their highest points in the early part of 1920, and has been generally falling since. The price of cotton from its highest to its lowest is about 10 taels or about 14 dollars per picul. It takes about 3½ piculs to make a bale of yarn, thus making about 35 taels difference in the cost of raw cotton at the two different periods. Adding the difference in the cost of raw cotton to the low price of yarn, it is evident that the actual profit made per bale by cotton mills differs but slightly from that of 1920. The following figures show the price of yarn and raw cotton in each month during the mentioned months. The Tungchow cotton and 16's yarn from a Chinese mill in Shanghai are taken as the standards :—

	Yarn. Taels per bale of 400-lb.		Raw Cotton. Taels per picul.	
	highest.	lowest.	highest.	lowest.
January ..	195	190	33.25	32.50
February ..	208	198	33.50	33.25
March ..	209	202	34.25	32.75
April ..	201	188	33.95	33.00
May ..	188	168	33.50	32.25
June ..	192	172	32.00	31.00
July ..	178.50	165	34.00	33.00
August ..	173.60	162.20	32.00	28.50
September ..	164.50	150	30.00	28.50
October ..	155	148	28.50	24.50
November ..	157	137	25.50	24.00
December ..	139	131	24.00	22.00

From January to April of this year the price of cotton remained practically stationary, that is from 22 to 24 taels per picul, while the price of 16's yarn fluctuated from 132 to 140 taels per bale. The causes of the decline are many, but the chief ones are the industrial depression in Japan, which caused a dull yarn market in that country and in turn affected the Chinese yarn market, the decline in the price of American cotton, and the increase in the number of spindles in China since last year.

Very few mills are equipped with English machinery. There are many British firms in Tientsin who are agents for British textile machinery, but they are doing very little business because they cannot give definite delivery dates. Textile machinery makers, as well as those who are interested in textiles in general, should bear this condition of delivery in mind. This is a new field, and with certainty the demand for both manufactured goods and machinery will be enormous as time goes on.

The New Canton

By Orrin Keith

THE metropolis of South China is rapidly growing away from its ancient reputation for narrow streets and overcrowded houses. There are still many of both but the new-comer now receives his first impression of broad avenues and modern, and in some cases really excellent, buildings. So rapidly is the change taking place that even those who leave the city for a stay of two or three months return and exclaim at the transformation.

The scheme of tearing down the old city wall and replacing it with boulevards was first broached in 1911 by T. T. Ching, a returned student, and then commissioner of public works in the days immediately following the revolution. Nothing came of the matter at that time, however, and the troublous years which followed allowed no opportunity for such improvements. Not until the end of 1919 was the plan revived. Then Ngai Pong-ping, commissioner of police under the Kwangsi government of Mo Wing-sun, tore down the city wall and began constructive work under Ching's plan. This government completed the paving of 37,000-ft. of highway.

That the end in view was something more than the modernization of Canton there is considerable evidence. Mo, or Mok as he is known locally, organized a syndicate among his friends and they bought up the property on both sides of the proposed roads. This property had an average value of perhaps $200 per *chien*. Mok, however, was military governor of the province, and, moreover, he belonged to the old school of officialdom. He decreed that this property was worth $5 per *chien* and forced the transfer of the title to his syndicate at this price. Even this was not paid too often and when the Kwangsi militarists and their henchmen were ejected at the end of 1920, they left creditors to the extent of $1,500,000 clamoring for the pittance they had been allowed for their land.

Another transaction of interest was the acquisition of the lands of the bannermen. Up in the north-west corner of the city were several hundred acres which, because of the distance from the gates, were so inaccessible as to be of comparatively little value. With the walls down, however, these would face a boulevard and be immediately opposite a very crowded portion of the extramural city. Their value would therefore be greatly enhanced. The syndicate tried to persuade the bannermen to turn these lands over to them on the agreement that the syndicate would assume the obligation to pay them as long as they lived the same income they had formerly received. Even a bannerman could see some doubtful points in such a scheme. So the syndicate changed its tactics and offered to buy the property at a price which would yield the same income. This sounded more reasonable. The money was to be deposited in the government bank. The deeds were to be turned over to the syndicate. Then the bannermen were to get their money. All went according to program until the last step was reached. When the bannermen called for their money after delivering their deeds, the bank was very sorry, but the government had requisitioned that money for other purposes!

If the beginning of Canton's transformation was closely associated with the sordid methods of the old mandarinate, the later developments make cleaner reading. At the end of 1920 the Canton municipality was formed. It fell heir to the work of city improvement, although it could make no effective claim to the $10,000,000 its predecessors are alleged to have made out of the project up to that time.

The new men at the helm seem to be of an entirely different mold. They have taken up and even extended the plans for municipal development but have so far kept themselves clear of all charges of graft or extortion. They have even paid a portion of the indebtedness which the old gang left and are making arrangements to pay the remainder. The entire system of acquiring the necessary lands and properties has been remodelled. Instead of the syndicate system and its corollary of private and official graft, they have instituted the American system of condemnation and assessment. The owners of properties taken are to receive due compensation and the owners of properties benefitted are to pay the cost of the improvement.

The most important development under the new plan is the continuation of the bund from its present termination opposite the east end of Shameen westward along the Shameen canal to the western end of the city. The present road is twenty feet wide. The new bund is to be eighty feet. The city commission has placed a value on the property which it is necessary to take for this purpose at an average of $250 per *chien*. If any property holder is dissatisfied with the amount allowed him for his property, he may ask for arbitration. The board of arbitration will consist of two members of the commission, one member appointed by the property owner, one member appointed by the chamber of commerce, and the provincial recorder of deeds. Their decision will be final. It may be contended that the property owner has but little representation on this board. The decision, however, has passed from those who place their own profit above all scruple, to a disinterested majority at least. This is a favor, and not a small one, for which the property owner ought to be, and is, duly thankful.

The property acquired and the street constructed, the next step is to apportion the cost among the holders of property fronting on the new bund. It is estimated that such property will be worth at least $325 per *chien*, though this is considered a very low estimate. The former value of each piece will then be assessed by the department of public works and the owner required to pay the difference between such assessment and $325. He has the same right of appeal to a board of arbitration as is provided in the case of the condemned property.

The plan in general is to put through these improvements in such a manner that the properties benefitted will just pay the actual cost. Neither the city nor any individual is expected to make anything. It requires considerable courage to really believe that nobody will make anything in such a series of transactions. And yet the present city government has kept itself remarkably free from even the suspicion of private profit.

The average width of the main avenues at the present time is about eight feet. It is intended to widen all the avenues to at least twenty feet. This is not to be done according to any fixed plan of reconstruction but as different parts of the city are destroyed by fire, the property owners will be required to rebuild under new regulations. This plan too is in part a heritage from the old *regimè*—but with a difference. Under the old government, when a district burned, the house-owners were required to build back to a new line. The exact location of this line, however, was carefully concealed. In fact, it was not fixed at all. The amount the owner had to go back from the old line therefore depended largely on how much squeeze he paid to the officials in charge. Under the new administration, whenever a street is burned, the entire street is surveyed and the ultimate lines are fixed and published. There is no favor and no graft. It is estimated that the entire city will be rebuilt under this "fire-and-reconstruction" method in about twenty years.

Meanwhile another improvement is receiving the attention of the department of public works. Parks or public gardens are not usually associated with Chinese cities. But the new Canton is to have these in adequate measure. Already there is one in the centre of the city which has been handsomely beautified after the Occidental fashion. Its area is about 7,000 *chien*. To the north of this, running up to the old north wall of the city, is the hill of the goddess of mercy. This is beautifully wooded and requires little in the way of artificial treatment to make it a delightful park. Heretofore it has been largely shut off by the location of various yamêns and other public properties so that its beauties have been accessible only to the favored few. Now it is planned to open it up by running the necessary boulevards and convert it into a public park.

A third plan calls for an extensive public playground in the eastern part of the city. This will have a large athletic field, track, ball-grounds, etc. Here the new China may disport itself after the manner of the young men—and young women—of the West. The fourth project is for a small park on the island just east of the end of the bund. The bund will be carried across the canal and the canal itself filled. This will be largely a show place as a terminus for the bund.

Even more ambitious is another project of the new administration. Canton makes no effort to hide under a bushel its light as the "livest" city in China. But if numbers are to be taken into account, it is a city of the dead. A survey recently completed gives the estimated number of graves within the present city limits as over 18,000,000! Eighteen million ancestors sharing Canton's supersaturated area with a million and a half of their living descendants!

The extent of this supersaturation is apparent from another survey. Canton has only 120,000 buildings. Of these 30,000 are stores, godowns and other business structures. The result of the survey is an estimate that, in spite of the number of people who have taken to boats—over 50,000 in the city itself—there is an average of twelve to fifteen persons in every dwelling house in Canton! As a great many have only five or six, there are also many which run as high as twenty or thirty!

A really pressing problem then, is some provision for new dwellings. And the proposal to extend the city in any direction meets with immediate objection from some of the eighteen million ancestors! This objection was conclusive in former times. But the new governors of Canton have decreed that if the necessity for homes for the living conflicts with the rights of the dead, then the dead must move! And the migration has already begun. A tract of some 48,000 *chien* on the outskirts has been declared suitable for building purposes. The city has begun the work of exhuming the coffins. In one small corner of it during the month of November they found 20,000 coffins. These are exposed for identification and when identified are turned over to the relatives together with a payment of $3 to $10 to pay for reburial elsewhere. As fast as the graves are removed the property will be sold for homesites.

The money obtained from this development will be used to commence the construction of Canton's sewer system. There is a temporary sewer along the line of the old moat before the city wall and the new boulevards are provided with sewers, but no general arrangement has been made as yet. The need for such a system it is not necessary to dwell upon.

Among the lesser enterprises of the public works department are five public slaughter-houses and two public markets. Much of the disease of the city has been rightly or wrongly attributed to the practice of the private killing of animals and the exposure of the meat for sale uncovered in open stalls along the dirty streets. In time all animals will be slaughtered in the public slaughter-houses under sanitary inspection and the sanitary requirements for the sale of meat will be much more stringent.

One more plan of the new government, even though it is still in the making, is of interest. There are in Canton a number of old yamêns, and other government properties with extensive grounds. The land is extremely valuable but the buildings are in few cases suited to the present needs. It is proposed to sell all of these properties. This would serve the double purpose of giving more area for home building and bringing in to the city treasury a large sum of money. This money it is proposed to use in the construction of a civic centre with modern buildings to replace the present yamens. The site at present favored is on the island of Honam, across the river from the old city of Canton and not far from the Canton Christian College.

Such are the plans. They are ambitious. Not so long ago they would have been laughed at as vain dreamings. But to-day so many of them have been actually realized, and the way seems so clear for the rest of them, that they can no longer be laughed at. Canton is apparently determined to be a modern city. And Canton is rapidly becoming one.

New Amoy Telephone System

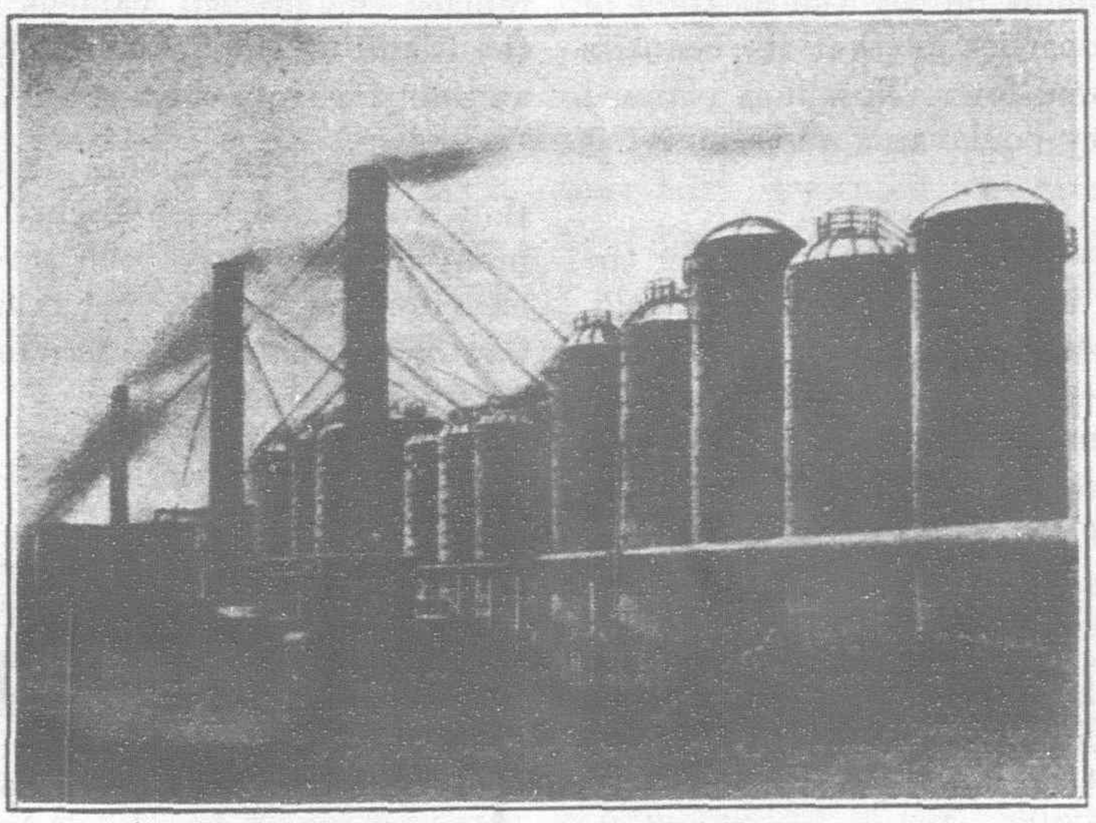
THE Kellogg Switchboard and Supply Company have just signed a contract for the installation of a complete new telephone installation for Amoy, which calls for a 1,500 line common battery system, with 1,000 wire miles of copper cables. Submarine cables for ten simultaneous connections will connect the island of Amoy with the Foreign Settlement of Kulangsu Island. The contract also includes poles, cross arms, insulators, and all pole line hardware. No part of the old system will be used in the new installation.

Mr. Oei Tjoe

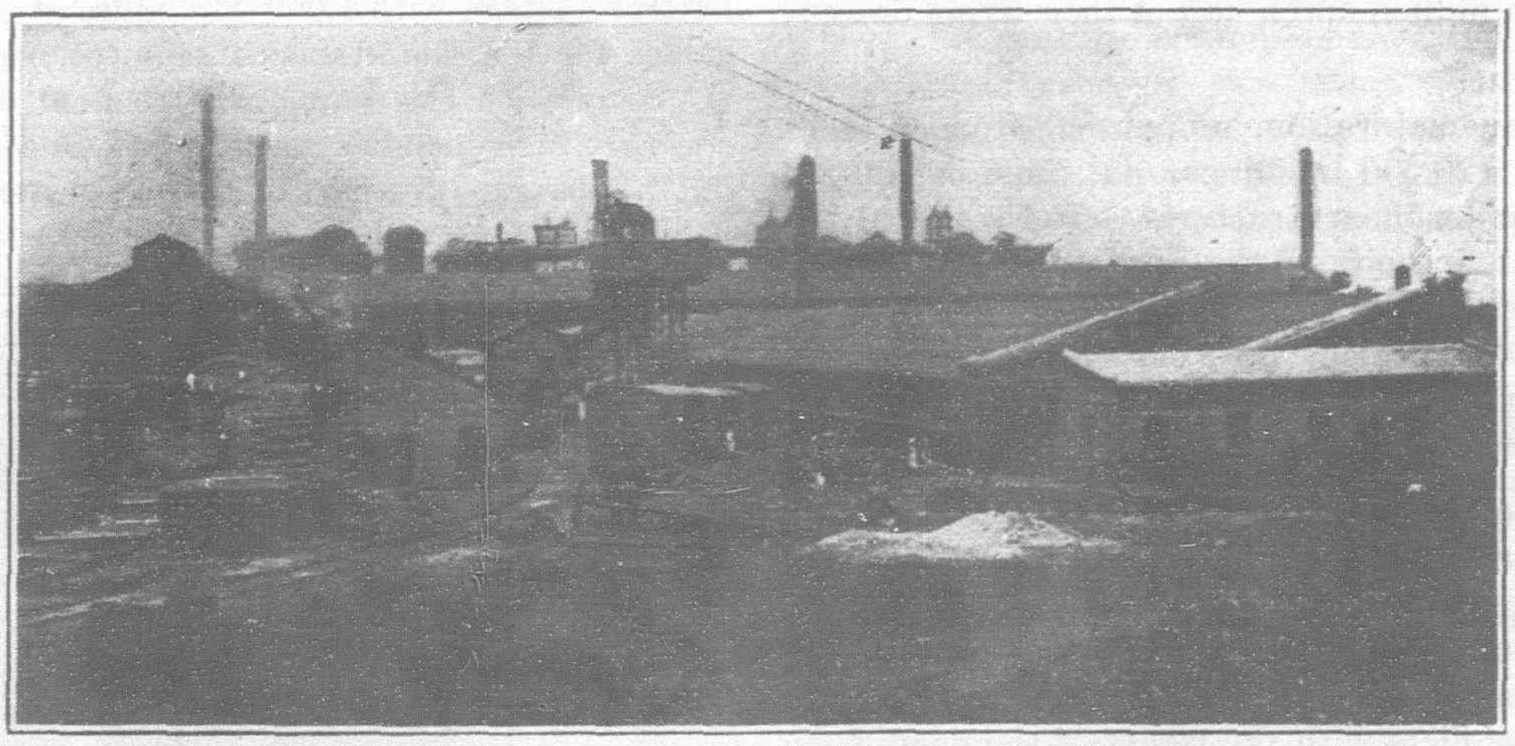
The new enterprise is due to the civic patriotism of Mr. Oei Tjoe (I. Joe Hwang) a Chinese multi-millionaire whose signature is said to be good for 5,000,000 pounds sterling. A native of Amoy, he drifted to Java and entered the business of coolie contracting for the sugar estates and other enterprises, and in course of time invested his earnings in sugar properties. The wave of war-time prosperity carried him into the millionaire class. He is credited with founding the China and South Sea Bank, Ltd. in which he is the largest stockholder. Returning to Amoy to enjoy the remaining years of his life in his ancestral home, he determined to contribute something to the welfare of his city. The extremely poor service of the local telephone system provided him with this opportunity and the outcome is the contract with the Kellogg Switchboard and Supply Company for a complete new plant.

ASIATIC STEEL WORKS.—1. The Bengal Iron Works

THE Bengal Iron Co., Ltd. was registered in December, 1919, with an authorized capital of £2,500,000 to acquire the Bengal Iron & Steel Co., Ltd. The works are situated at Kulti in Bengal on the East Indian Railway, 142 miles from Calcutta. It has already been shown how the latter company, founded in 1889, was the lineal descendant of the Barakar Iron Works Co., Ltd., which was started in 1875. In 1889 the plant consisted of two small open-top furnaces, only one of which was worked, for which the blast was heated by coal in pipe stoves, and one blowing engine with its complement of boilers which were entirely fired by coal. The production of pig iron in 1889-90 was about 9,000 tons per annum, and was disposed of to government establishments either in that form or in the shape of castings. The foundries then covered an area of 12,300 sq. ft., and the production from them was 3,800 tons per annum. At that time the company did not own its own collieries, but purchased its coal and coke requirements in the open market. The site of the works was chosen originally on account of the close proximity of both coal and iron ore supplies, and for many years the clay ironstone nodules that formed the ores for the furnaces were obtained from a geological horizon in the Gondwanas, known as the Ironstone Shales. This crops out between the coal-bearing Barakar and Raniganj stages, and stretches for some distance east and west of the works. The iron ore was obtained by contract with the local proprietors of bullock carts, and the supply was uncertain in quantity and variable in quality.

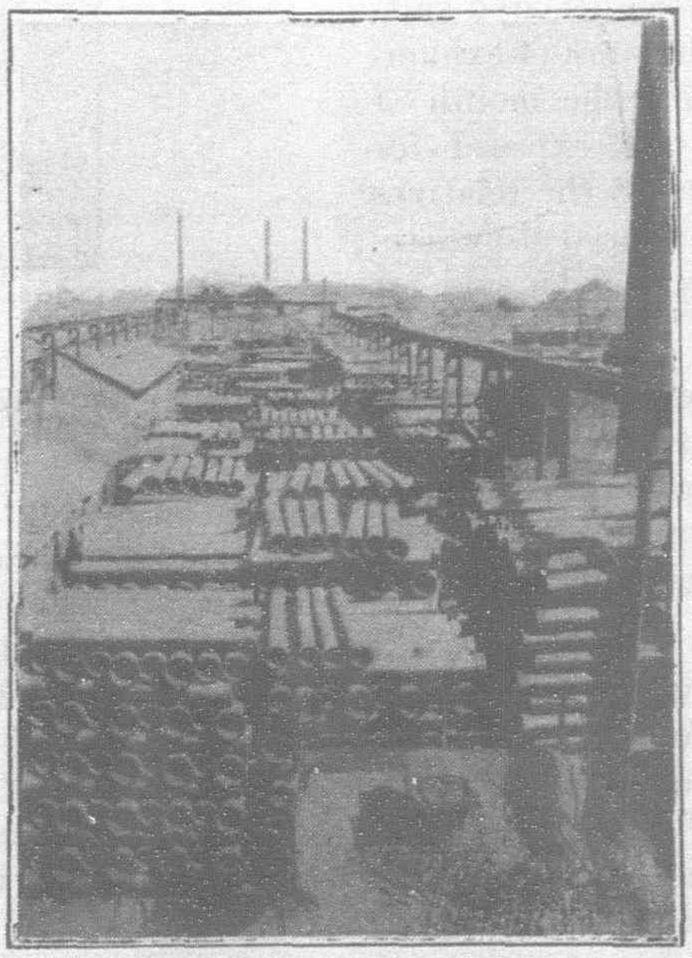


Bengal Iron Works: View of Furnaces



Back View of Bengal Iron Works, Showing Pipe Foundry

The remodelling of the works was taken in hand at once. The two original blast-furnaces were converted into close-top furnaces to enable the gas to be utilized for firing the boilers. At a later date, as they required rebuilding, they were removed and replaced by two modern furnaces. A new furnace was also erected, fitted with three 17-ft. diameter Cowper stoves. During the period up to 1914 steady progress was made; collieries were purchased and developed, namely, Noonodih, in the Jherria field, in 1905, and Ramnagar, 1½ miles distant from the works, and connected with them by a light railway, in 1907. By 1908 several small iron ore areas had been acquired, one of which was at Kalimati (now Jamshedpur), close to the site of the present Tata iron and steel works. With the opening up of the company's mines at Manharpur, in the Kolhan Estate of Singhbhum, in 1910, a constant supply of first-class hematite was assured, for already many millions of tons of high-grade material have been proved, and the use of the ore from the Ironstone Shales was finally discontinued. The outbreak of the war found three furnaces in operation with an annual output of approximately 80,000 tons of pig-iron, each furnace with its four Cowper hot-blast stoves, and the whole plant operated from a modern power-house containing three turbo-blowing engines of a total horse-power of over 4,000. The plant in existence today will now be described.



Pipe Stock Yard. All Pipes are Made to British Standard Specification

There are four furnaces in operation, a fifth under construction, and twenty stoves for heating the blast; seventeen of the latter are 65-ft. high by 21-ft. in diameter, and three are 55-ft. high by 17-ft. in diameter. On the completion of the fifth furnace the total capacity of the plant will be 175,000 tons of pig iron per annum. The blast is supplied from turbo-blowers of the Parsons type, with a total capacity of 115,000 cub. ft. of air per minute. There are twenty-four Lancashire boilers, fired by waste furnace gas, in two batteries, supplying steam to the blowing engines. The iron ore, coke and limestone are delivered from railway wagons and raised to the charging hoppers by two steam and electric hoists. In the case of No. 5 furnace, a Brown Hoisting Co.'s charging apparatus has been provided. The slag is removed in Dewhurst ladles and taken to the tip in a molten state.

The coking plant consists of three batteries each of thirty-four Simon Carves by-product ovens, with an out-turn capacity of 130,000 tons per annum, complete with recovery plant for coal tar and ammonia, and also sulphuric acid plant. A fourth battery is under construction which will raise the total output to 200,000 tons per annum. The present raisings of coal from the company's collieries (Khendwa

and Ramnagar in the Raniganj field and Noonodih in Jherria) are about 150,000 tons per annum, but are being increased to 250,000 tons. The requirements of the coking plant are drawn from these and other sources. The coal is discharged from railway wagons into hoppers, whence it is elevated to the crushing machines and thence to the storage bunkers. It is compressed before entering the ovens.

The waste heat from the ovens passes to a battery of boilers, where it is used in raising steam for the electric generating plant, which has a capacity of 2,500 kw. and provides power and light throughout the works, to the Ramnagar colliery, and to the pumping station at Monberia on the Barakar River.

The area occupied by the foundries has increased from 12,300 sq. ft. in 1890 to 175,000 sq. ft. to-day. This department comprises pipe foundries, railway sleeper and chair foundry, general casting foundry and brass foundry, together with pattern shops, etc. Pipes are made in dry sand moulds and vertically cast. One plant is fitted with hydraulic and the other with electric power. Flanged pipes of all sizes for steam or water mains are made. During the war the company supplied many miles of pipes for Mesopotamia and the north-west frontier, in addition to 20,000 tons of high-grade ferro-manganese made from Indian ore and dispatched to America, France and Italy. Large quantities of railway sleepers were also supplied for extensions in various military zones. The railway sleeper foundry is fitted with moulding machines for making both plate and bowl designs.

In the general foundry all kinds of castings up to 10 tons in weight are manufactured, including columns for buildings and mills, straining posts and sockets for fencing, mortar mills, road rollers and machinery castings, ornamental columns, lamp-posts, railings, etc. The foundries are capable of turning out 60,000 tons of castings per annum divided as follows : pipe 15,000 tons, sleepers and chairs 30,000 tons, general castings 15,000 tons.

The Bengal Iron Co., Ltd., to-day employs about 100 Europeans and 15,000 Indians, and every effort is made to cater for the physical well-being and comfort of both. A modern hospital administers free medical treatment. Foodstuffs are issued at cost price, while schools for boys and girls have been built and are principally financed by the company.

2. The Lungyen Steel Works

ONE of the most interesting and useful additions to industrial China is the 250-ton blast furnace plant of the Lungyen Mining Administration, now under construction at Shiechingshan, eleven miles west of Peking on the Mentakow branch of the Peking-Suiyuan Railway.

The site is an admirable one, there being ample room on the great flat plain for the very extensive future expansion contemplated, sufficient water supply and connections with two railways ; the administration owning its own six-mile line making connection with the Peking-Hankow line at Loukowchow. The elevations chosen and the layout determined are such that the traffic about the plant will be conducted under ideal conditions, second to none anywhere. Ore, coke and limestone are received and go to the stock handling system or to the stock piles without crossing any other yard track at grade. Iron, slag and incoming materials have each their own separate lines. Traffic interference will be reduced to a minimum. The location of the present plant was formerly a low rock hill which has been leveled leaving the foundations of all structures in solid rock.

The plant was designed by Perin and Marshall, of New York, and the materials are all of American manufacture.

Mr. G. Gordon Green is engineer-in-charge of construction.

The furnace is of latest American design, 85 feet from hearth to charging platform, 13-foot hearth and 18-foot bosh. The eight columns are of built up structural steel and there are eight tuyeres offset from the columns to give maximum working space. The hearth jacket is of steel plate, lined with cast iron cooling plates. Two iron notches are provided, one above the other, to facilitate tapping when the furnace is working badly. Two cinder notches are also provided, at the same elevation and ninety degrees from each other, to give relief in case of accident to one of them. The tuyere and bosh jackets are of heavy steel plate with the usual type of bronze cooling boxes. An added ring of permanent cast iron cooling boxes is inserted in the brick lining above the mantle, near the bottom of the first ring of shell plates. The brick lining was made in America, the top fifteen feet being protected from the incoming charge by cast iron wearing plates laid in small units in the lining itself. The furnace top is a Marshall design with double skip hoist, distributing hopper and two bells enclosed in a gas tight housing. Four bleeder pipes extending 43 feet above the charging platform carry the poisonous gases well above all working levels. These four bleeder pipes also carry the bell lever, skip sheave and bleeder valve platforms. From them also, at a height of 15 feet above the charging platform, are taken the two downcomers, instead of from the shell itself, thus minimizing the amount of coarse material and heavy dust carried out by the gas. The gas passes from the downcomers through two 20-foot dustcatchers where the bulk of its dust is removed, thence through the gas mains to the stoves, where it is burned to heat the blast, and to the boilers.

The iron notch is closed by a Vaughn steam mud gun, and the arrangement of the furnace floor is such that the operator can see the operation of the stock and filling systems at all times.

There are four stoves, 20 by 80 feet high, of a simplified design, two pass, with side combustion chamber. The stoves are fitted with an inverted type of Spearman burner, mushroom hot blast valves, spectacle chimney valves and slide cold blast valves. A stairway runs from the ground to the platform around the top of the stoves, whence another stairway continues to the furnace charging platform.

There is also another stairway from the ground to the furnace top, up the skip bridge.

The design of the stoves is a Marshall two pass type with the checkers of standard bricks instead of special shapes. Special provision is made for uniform gas supply to all checker flues.

From the stoves the waste gases are carried off through an overhead flue to a steel stack, 175 feet high, 8 feet diameter, and brick lined throughout.

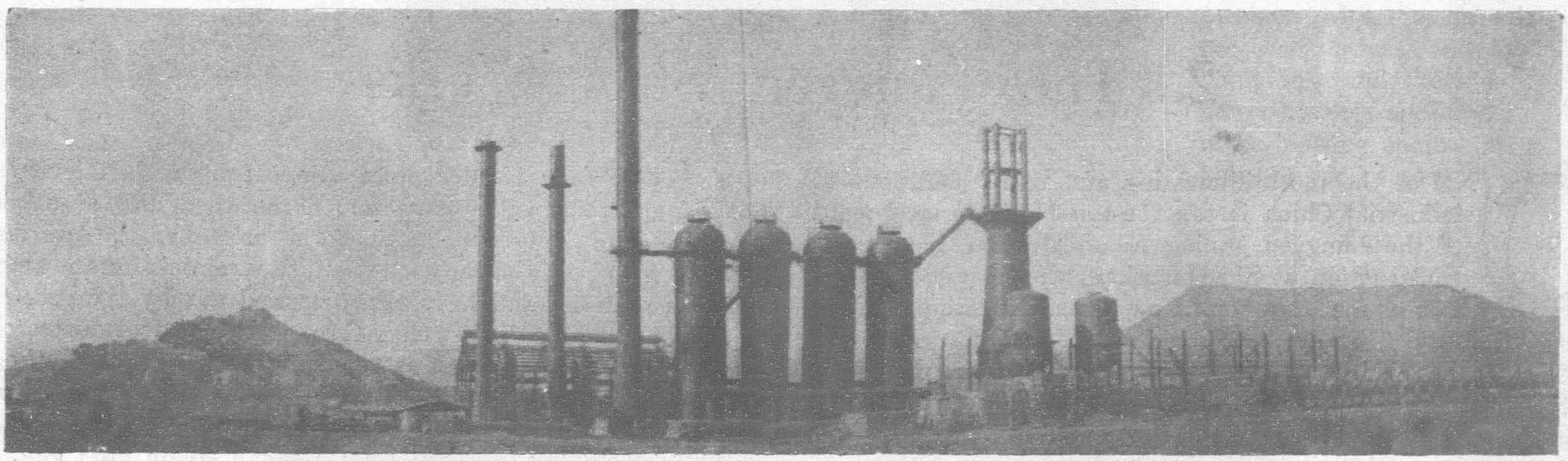
The gas burners at the boilers are of the venturi type, giving automatic control of air admission at all gas velocities. There are five 500-horse-power Wickes vertical water-tube boilers with Foster superheaters, working at 200-lb. pressure and delivering steam at 165 degrees of superheat. Waste boiler gases are carried off by three 150-foot steel stacks, brick lined throughout, one chimney to each pair of boilers.

Steam is delivered to the adjacent power house, fifty by one hundred and twenty feet floor space, wherein are housed two 20 by 30-inch Norberg uniflow engines direct connected to two 250 K.W. generators, one only running ; two Ingersool-Rand turbo blowers, one only running ; Worthington boiler feed pumps, air compressor for casual use about the plant, and jet condenser. Generators supply power to pumps, machine shop and larry car, to various motors about the plant, and for lighting.

Both boiler house and power house are of structural steel, roofed with corrugated sheets, the boiler house having corrugated steel sides, the power house having brick walls.

Ore and limestone are delivered to the furnace through a concrete tunnel stock system and there are no bins for these materials. The tunnel, 360 feet long and 17 feet inside width, the top being level with yard level, carries a concrete trestle with two standard gauge railway tracks twenty feet above. Ore and limestone are discharged from the cars through the trestle and fall directly on the tunnel arch and on the ground. They then pass through openings in the tunnel arch by chutes and shut-off gate into the scale car traversing the tunnel. This car, automatically weighting its load, carries it to the skip pit opposite the furnace, which is twenty feet below its own tracks, where it discharges by gravity into the skip car which delivers it to the furnace top. The skip cars are hoisted by a double-drum reversing Otis elevator steam hoist, the two cars traveling in opposite directions at the same time.

Coke is stored in a steel bin directly over the ship pit. As the coke drops into the scale car, it passes over a grizzly, and the braize, or fine coke, is screened out. This braize falls on to a concrete platform and is wheeled out by hand up a ramp to the dump.



New Blast Furnace of the Lungyen Mining Administration, near Peking

One of the interesting problems is water supply. The plant requires ten million gallons daily, eight millions is recovered but two millions is lost and must be made up. The water supply, the Hun Ho or Yung Ting River, contains normally about one per cent. of sediment which must be removed. A pumping station at the river side, three quarters of a mile from the furnace, equipped with two electrically driven centrifugal pumps, each of two and a half million gallons daily capacity, deliver the river water to the settling tanks, where the sediment is removed and run to low ground nearby for the use of the farmers. An earthwork reservoir of sixty million gallons is located near the furnace and a concrete reservoir an enlarged pump of half a million gallons capacity, together with a pump house, water treating plant and a ninety-foot water tower is located adjacent to the power house.

For the present, iron is to be cast in the sand in the cast house, two hundred and forty-four feet long by sixty feet wide, and carried out when cooled by hand, or with a traveling crane. Slag goes to the ample dumping grounds by Pollock side-dump steam-dump cinder pots. Other auxiliaries include two Baldwin saddle tanks, sixty-ton locomotives, one fifteen-ton industrial locomotive crane, an ever expanding machine shop and blacksmith shop and a foundry.

The grading and excavation was commenced early in 1921 and the concrete work in May. Steel erection was commenced in July, and according to the present schedule, based on work already done, the furnace should make iron sometime next spring. If this is achieved it will be a time record upon which the administration may justly pride itself.

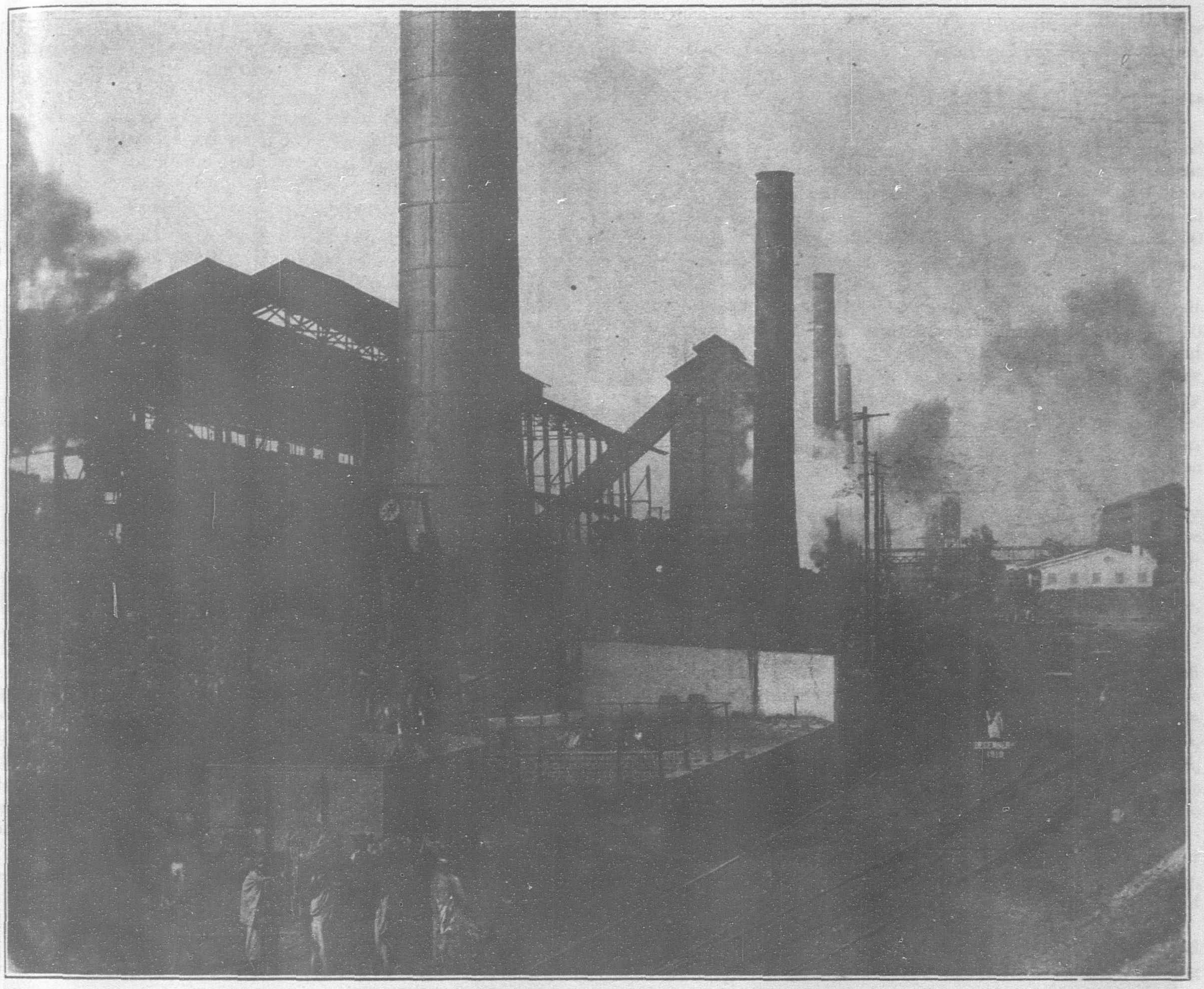
This plant is the first unit of a steel plant which includes for future construction other blast furnaces, by-product coke ovens, open hearth steel furnaces, rolling mills, bar and merchant mills, rod mills, sheet mills and other units of a great modern steel plant.

The Lungyen Mining Administration was organized in 1918, and is capitalized at five million dollars Mex., half of which is subscribed by the Chinese government, the other half being owned by individuals, most of whom are prominent men in China. The company has been granted mining rights to exploit the Pang-chia-pao and Sin-gao iron ore deposits of Ling-kwan hsien, the Yen-tung-shan deposits of Hsuan-hua hsien and the Shih-fu-shan deposits of China-hsing hsien, all in the province of Chihli. The total workable reserves of high grade ore of the three areas are estimated to be one hundred million tons. The ores are all hematite of sedimentary origin and carry a little over 50% metallic iron. The Peking-Suiyuan Railway has built a six-mile branch line from Hsuan-hua to Yen-tung-shan, and a system of narrow gauge lines connects the various workings with the standard gauge railway; the cars loaded in the mines are discharged directly into the standard gauge cars. The mines began regular work in January 1919, employing about 2,000 men and produced 700 tons of ore daily. The mining work so far accomplished consists of an interesting system of tunnels and inclines. At the mines there are coolie quarters for 2,000 men, office buildings and a well equipped laboratory. The company has also wisely acquired several large tracts of land nearby and has planted trees to provide timbers for future mining purposes, a new acreage being planted yearly. The engineering staff consists of 20 men, all Chinese, and in 1919 over 150,000 tons of ore were produced. Mining work can be carried on practically every day in the year.

In order to determine the working qualities of the ore a trial smelting was conducted at the Hanyang Iron and Steel Works furnace at Hankow, from May to August 1919, using Lu-ho-kow coke and Tayeh limestone. The ore proved easy to reduce, and the fuel consumption was low, but with a comparatively large slag volume as might be expected from the analysis. The furnace worked remarkably well and the trials were eminently successful. The iron produced contained 3 to 4 per cent. total carbon, .4 to .9 per cent. combined carbon, 1 to 3.5 per cent. silicon, .2 to .4 per cent. phosphorus and .015 to .050 sulphur, these being maximum and minimum figures. The grades ranged from basic to one foundry.

Lungyen owns its limestone quarries 7 miles from the furnace site, and also its own standard gauge branch 4 miles long, connecting it with the Peking-Suiyuan Railway at Sanchiatien, near Mentakow.

The iron and steel production of any nation is always a vital factor in its business strength. It is a most satisfying sign of the times to see that China is increasing the development, for her own use, of iron, the most important of her natural resources, and it is certainly greatly to her credit, that the vision, the initiative, the capital, and so far as is now practical, the personnel, is and has been, wholly Chinese.—*Journal of the Association of Chinese & American Engineers.*



THE TATA IRON AND STEEL WORKS: COKE OVENS

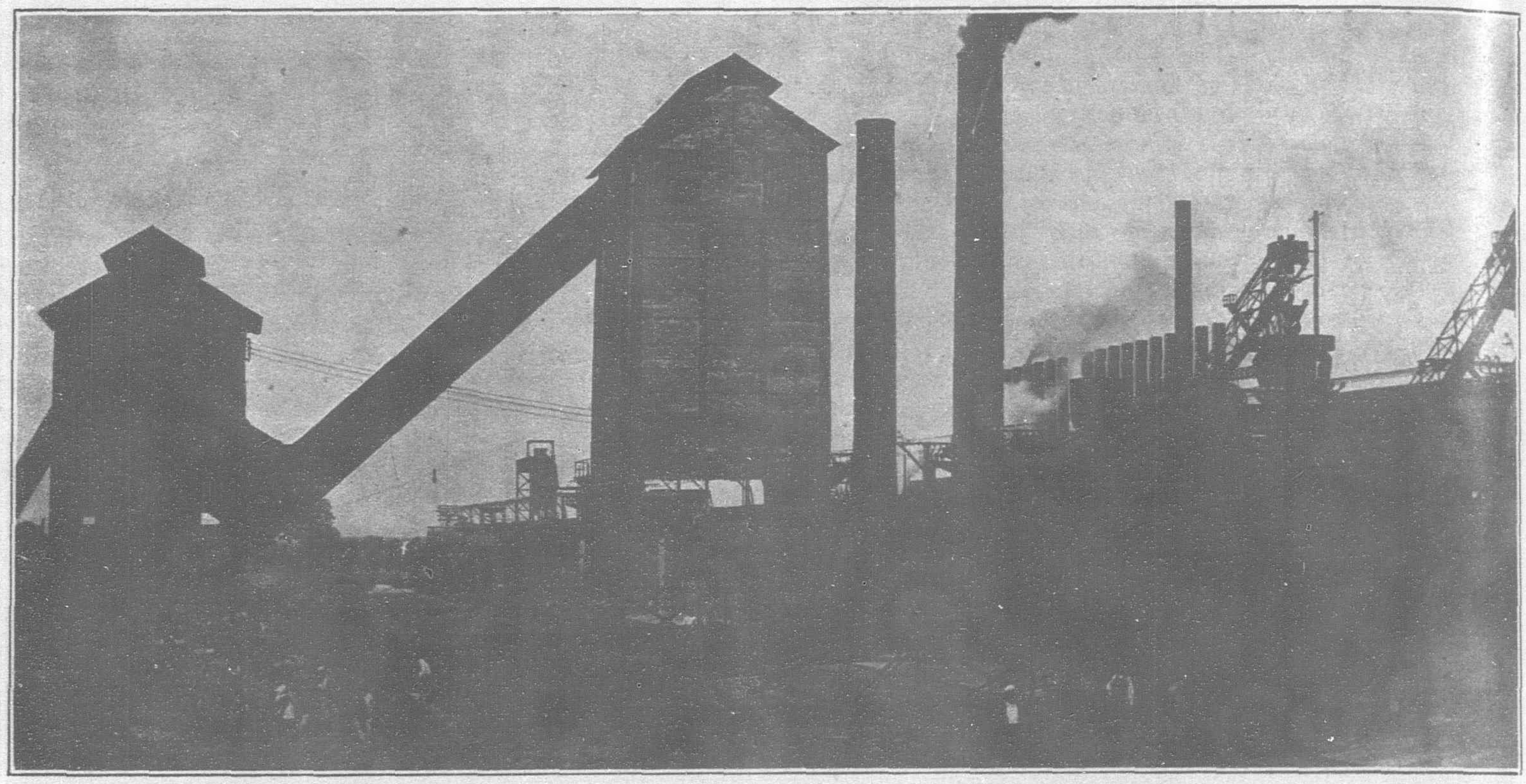
3. The Tata Iron and Steel Works*

JAMSETJI Nusservanji Tata, a member of the priestly caste of the Parsees, who was born in the State of Baroda in 1839, was the first Indian to realize the possibilities of an extensive iron and steel industry in his native land, and he also possessed the foresight to visualize the potential developments which have since come to pass. The operations of the Bengal Iron & Steel Co., Ltd., had already proved beyond question that pig iron could be made profitably in India, and it remained for Mr. Tata to institute the second iron-manufacturing concern and to introduce modern steel works and rolling mills.

The Tata Iron & Steel Co., Ltd., was formed in 1907 with a capital of Rs. 2,31,75,000 (£1,545,000). To-day it has an authorized capital of Rs. 10,52,12,500 (£7,014,166), of which Rs. 3,98,04,570 are issued. After preliminary investigations in India, Europe and America, Mr. Tata engaged Mr. C. P. Perin, of New York, as his consulting engineer. The latter's associate, Mr. C. M. Weld, arrived in India in 1902, and for some years examined various iron ore deposits, many of which had been discovered in the first instance by the officers of the geological survey of India. The earlier work was carried out in the central provinces, and large reserves of excellent ore were proved, but the forest resources of that region did not prove big enough to warrant the establishment of a charcoal iron works there. The surveys were then continued further on towards the east, in order to approach the coalfields of Bengal more closely, and finally the deposits of Gurumaishini in Mayurbhanj were chosen as the source of the iron ores.

The works are situated at Jamshedpur (formerly known as Sakchi), adjoining Kalimati station on the Bengal-Nagpur Railway. This place is 154 miles west of Calcutta, about 115 miles from the Jherria coal mines, 100 miles from the limestone quarries, and 45 miles from the Gurumaishini iron ore mines. The following description of the Tata works is compiled from papers by Messrs. Perin, Tutwiler and Surtees Tuckwell. The writer is especially

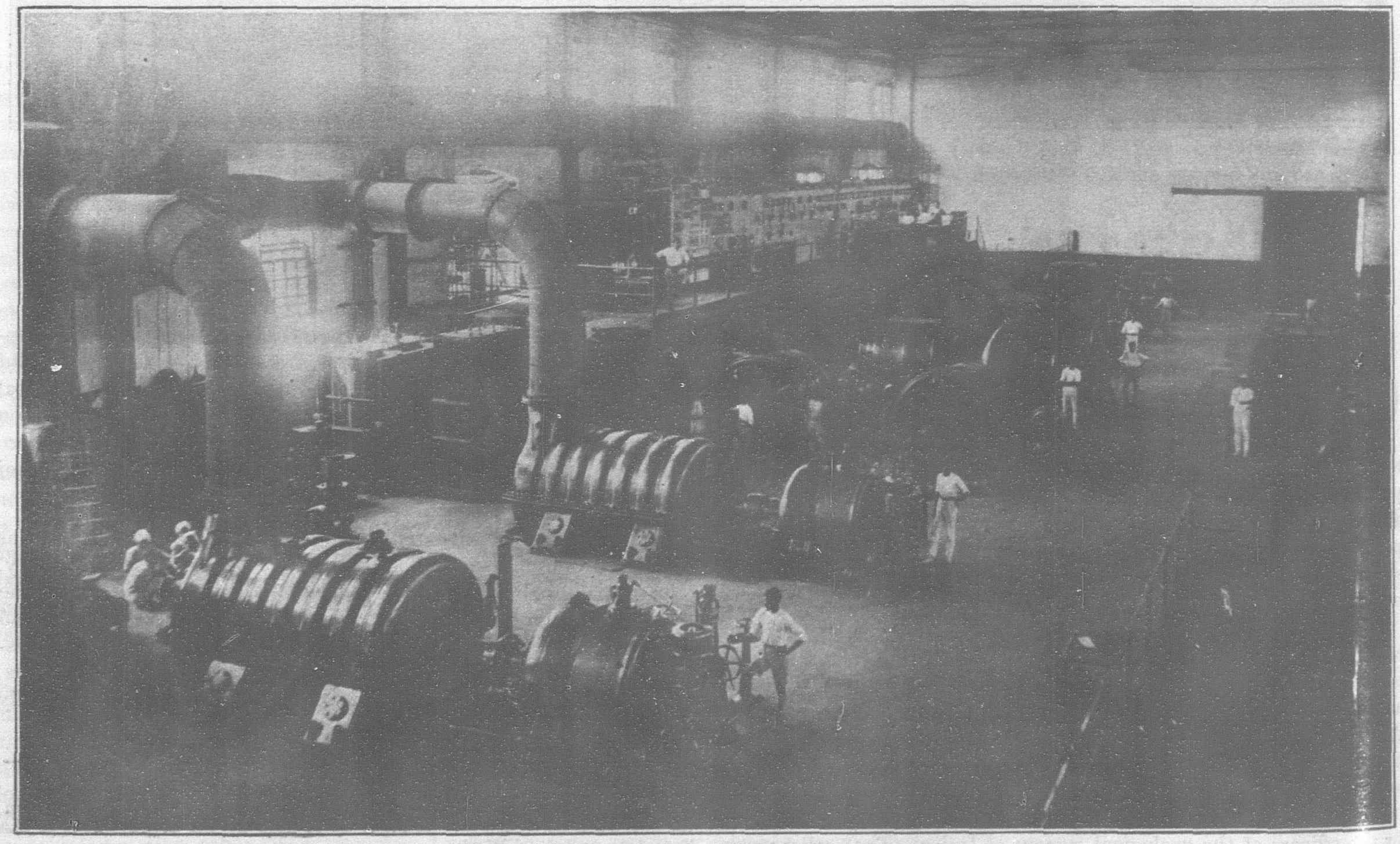
*This article appeared originally in *The Mining Magazine* of London, but has been corrected and brought up-to-date by the management of the Tata Iron and Steel Works.



TATA IRON AND STEEL WORKS: ANOTHER RECENT VIEW OF COKE OVENS

indebted to the last-named for his kind assistance. Construction commenced in 1908, and the Sakchi jungle was rapidly transformed into a town, which now promises to become the centre of one of the leading industrial regions of Asia.

The two original blast-furnaces of the company, each 77-ft. high and 19-ft. in diameter, with a capacity of 200 tons of pig iron per day, were blown-in in November, 1911, and September, 1912, respectively. Each furnace is equipped with up-to-date charging apparatus and four Cooper-Kennedy stoves. These two furnaces have since been enlarged to turn out 280 tons per day each. The shortage of ferro-manganese in India during the war led to the rapid erection of a third furnace of a somewhat smaller type in 1919. At the present time two of the most modern skip-filled furnaces, with a capacity of 600 tons per day each, are nearing completion.



TATA IRON AND STEEL WORKS: POWER HOUSE

The original coke-oven plant consisted of 180 Coppee non-recovery ovens. To these have been added a battery of fifty Koppers by-product ovens and a Simon Carves sulphuric acid plant, which supplies the acid necessary for the production of sulphate of ammonia. Three batteries of Wilputte design, each containing fifty ovens, are being added, together with extensions to the coal tar, ammonium sulphate, and benzol recovery plants. All the silica shapes requisite for the construction of these new ovens have been made in India by the Kumardhubi Brick Co.

The steel works plant consists of one 300-ton mixer, which receives the molten pig iron from the blast-furnaces before it is charged into the open-hearth furnaces. There are seven of the latter, four of which have a capacity of about 55 tons per heat and three of 75 tons capacity. These enable an output of 27,000 tons a month to be maintained. The new steel plant includes two 25-ton Bessemer converters, two 100-ton tilting open-hearth furnaces, and one 1,300-ton mixer. The converters will remove all the silicon and as much carbon as is desired from the iron, leaving the tilting furnace the duty of removing the phosphorus and sulphur and bringing the iron to the required percentage of carbon. The elimination of these elements is said to reduce the time necessary for the finishing of a heat in the tilting furnace by about 75 per cent. The large mixer is being erected to store the hot metal from the blast-furnaces over the week-ends, when the open-hearth plant is not working. The present 300-ton mixer is to be used as an additional open-hearth furnace after the new mixer is built. Provision has also been made for the installation of a 250-ton recarburizing mixer, a third converter if necessary, a third duplex tilting open-hearth furnace, and three Heroult electric furnaces for the manufacture of special steels or ferro-alloys.

There are four soaking pits in the steel works, equipped with mechanically operated lids, and an electric overhead charging and drawing crane. The ingots are made 21-in. by 19-in., and weigh between 2 and 3 tons each. They are removed by a self-tipping electric trolley to the mill tables.

The blooming mill consists of a 40-in. mill, operated by a Galloway engine of 11,000 h.p. In this mill the ingots from the soaking pits are made into blooms and billets. Another 40-in. reversing motor-driven blooming mill with hydraulic manipulator and followed by hydraulic shears is being added.

The present 28-in. finishing mill has three sets of rolls, and is worked by a 12,000 h.p. engine. It is capable of turning out rails from 100-lb. to 30-lb.; beams from 15-in. by 6-in. down to 5-in. by 3-in.; angles from 6-in. by 6-in. to 3-in. by 3-in.; and channels from 12-in. by 4-in. to 6-in. by 3-in. The blooms from the blooming mill are reheated before they are rolled, and the sections of rails or structural materials, after being rolled to the required dimensions, are cut by circular saws into the necessary lengths, and are conveyed mechanically by rollers to a cooling bed of the moving type. From the cooling bed all the bars and rails are passed through straightening machines in the finishing department, which also contains the usual planing and drilling devices. The products are handled by an overhead electric crane. The motor-driven blooming mill will serve a new 28-in. to 30-in. combination rail and structural mill.

There is one 16-in. bar mill making light rails weighing 30-lb. to 14-lb. to the yard; angles of all sizes from 3-in. to $1\frac{1}{2}$-in.; channels from 4-in. to $1\frac{1}{2}$-in.; beams of 4-in. by $1\frac{3}{4}$-in.; and fish-plates for rails. There are also two 10-in. mills devoted to the production of lighter sixes of flats, squares and rounds. The new bar mill is of the latest continuous type, and will take billets from the sheet, bar and billet mill at present under erection. Independent motor-driven rolls are being added for the production of wire rods.

The plate mill is now nearly completed in a separate building over 1,000-ft. long and about 100-ft. wide. The mill will produce plates from $\frac{1}{8}$-in. to $1\frac{1}{4}$-in. thick in various widths up to 96-in. and various lengths up to 50-ft. It is to be driven by a 2,000 h.p. motor taking alternating current at 3,000 volts, and is provided with bottom-type reheating furnaces. The building also contains the straightening and shearing machines for the plates.

The sheet, bar, and billet mill is in direct line with the new blooming mill, and will roll billets from $3\frac{3}{4}$-in. square to $6\frac{1}{2}$-in. square for the bar mills. It will also roll sheet bars up to 8-in. wide for the sheet mill. It is proposed to finish steel sleeper sections up to 16-in. wide on this mill.

The sheet bars will be delivered from the mill just described to the sheet mill proper, where six special furnaces will reheat them. The rolling equipment consists of two jump rolls, two balanced rolls, six finishing mills, and two cold rolling mills, all driven by a 4,000 h.p. motor taking alternating current at 3,000 volts. This mill will produce sheets to any width up to 38-in., and of any thickness desired from $\frac{1}{8}$-in. down to 0.01-in.

The present scheme of extensions also contemplates a bolt and nut shop with a sufficient number of machines to produce 50 tons per week; a steel sleeper press; a cast-iron pipe foundry; and a new roll-turning shop. A large new machine-shop is under erection, in which the housings, castings and the bulk of the heavy components for the new rolling mills, etc., are now being made. In addition there are shops for pattern-makers, carpenters, blacksmiths, locomotive repairs, electrical repairs and structural shops for bridge, roofs and buildings.

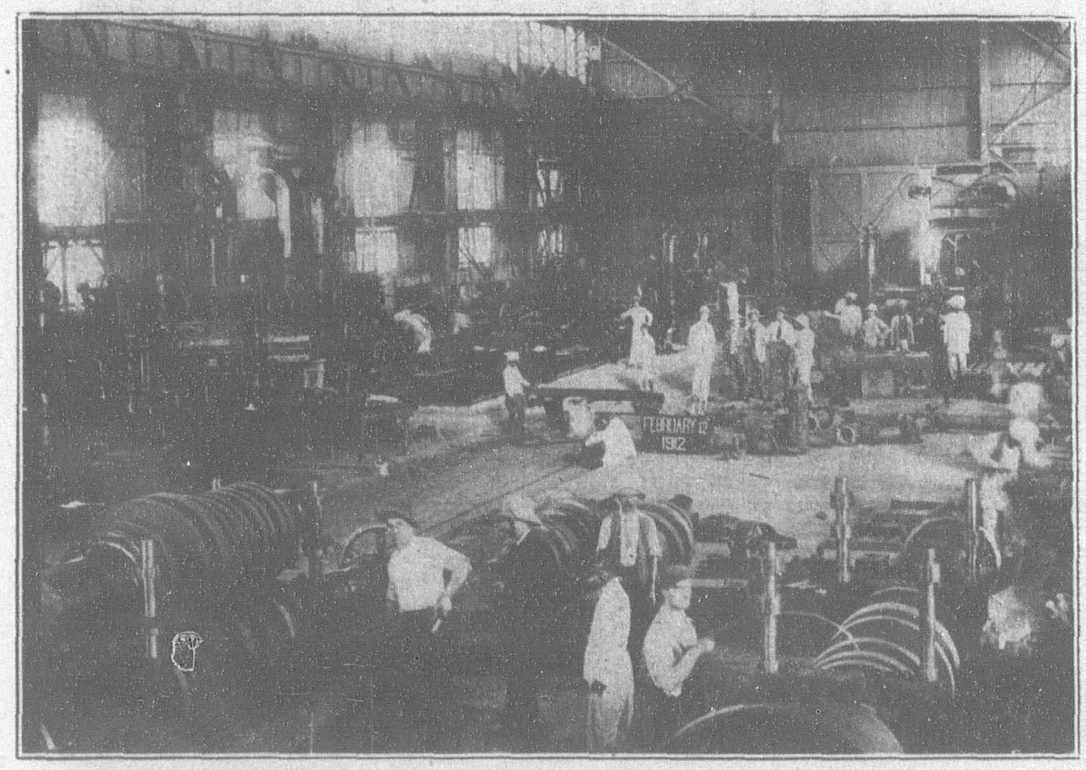
The power-house contains four turbo-blowers, which supply 32,000 cubic feet per minute to the blast-furnaces under a pressure of 15.5-lb. per square inch. The plant consists of one 5,000 kilowatt, two 1,000 kilowatt and one 1,500 kilowatt, 3,000 volt turbo-alternators, running at a speed of 3,000 revolutions per minute, and three transformers of 1,250 K.V.A., 3,000 to 440 volts, and two motor generator sets of 500 kilowatts each.

To supply the power for the new extensions, the whole of which will come into operation progressively within the next two years large additions to the former power-plant have been necessary. These include a large battery of new boilers, fired with blast-furnace gas, two 10,000 kilowatt, one 5,000 kilowatt, one 4,200 turbo-generators, one 2,000 kilowatt mixed pressure turbine, the steam for which is principally obtain from the existing rolling mill engines, and the necessary transforming equipment to step down from high to low-tension. Corresponding increases have been arranged in the water system, pumping plant, the transporting department, laboratory, offices, etc., to say nothing of the essential augmented reserves of raw material.

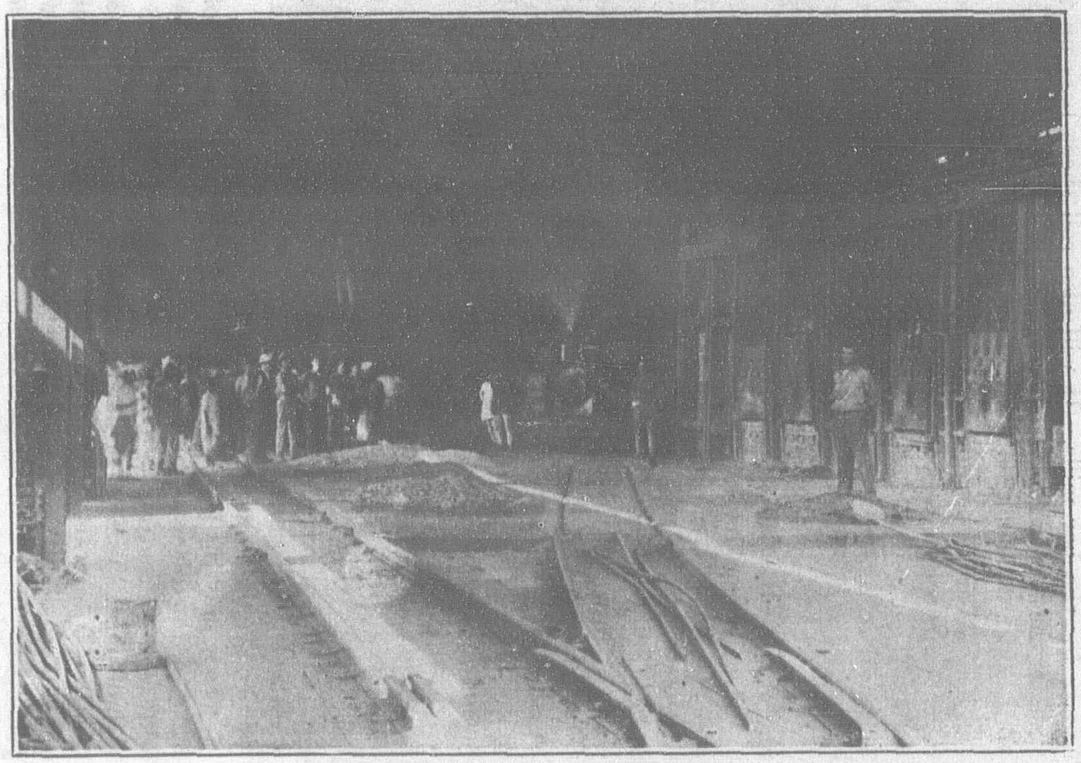
When the present extensions are completed, the Tata iron and steel works will have a potential output of 700,000 tons of pig iron and 580,000 tons of steel ingots per annum. Of the latter, it is proposed to convert some 426,000 tons into finished and semi-finished products, and the whole of the new plant has been so laid out that future extensions may be added with the least inconvenience.

The company owns its own collieries, iron ore mines, manganese ore mines, wolfram mines, and limestone and magnesite quarries. It also holds a large interest in the Kumardhubi Silica & Fire Brick Co., Ltd., which makes silica bricks from the gannister deposits of the Gaya region, magnesia products from Mysore magnesite, and other refractories from fire-clay, chromite, etc. The Tata Company to-day finds employment for 35,000 men and women, and, as it is still the custom of the ignorant to under estimate the capability of the Indian workman, it may be pointed out that the management has gradually been able to reduce the number of European and American employees and to substitute Indian labor. Out of 137 covenanted Europeans and Americans, 75 are employed as supervisors at the steel furnaces and rolling mills, which between them find employment for 4,200 men. At the blast-furnaces there are only 8 Europeans to 1,600 Indians; in the mechanical department 6 to 3,000; and in the traffic department only 1 to 1,500. The chemical laboratory originally employed five European chemists. Now only the chief is a European, the remainder of the staff being twenty-one Indians. According to Mr. H. Surtees Tuckwell, "in very many instances Indian workmen have shown themselves possessed of extraordinary skill and manual dexterity, and the electrical department is under the superintendence of an Indian gentleman, a graduate of an Indian

TATA IRON AND STEEL WORKS



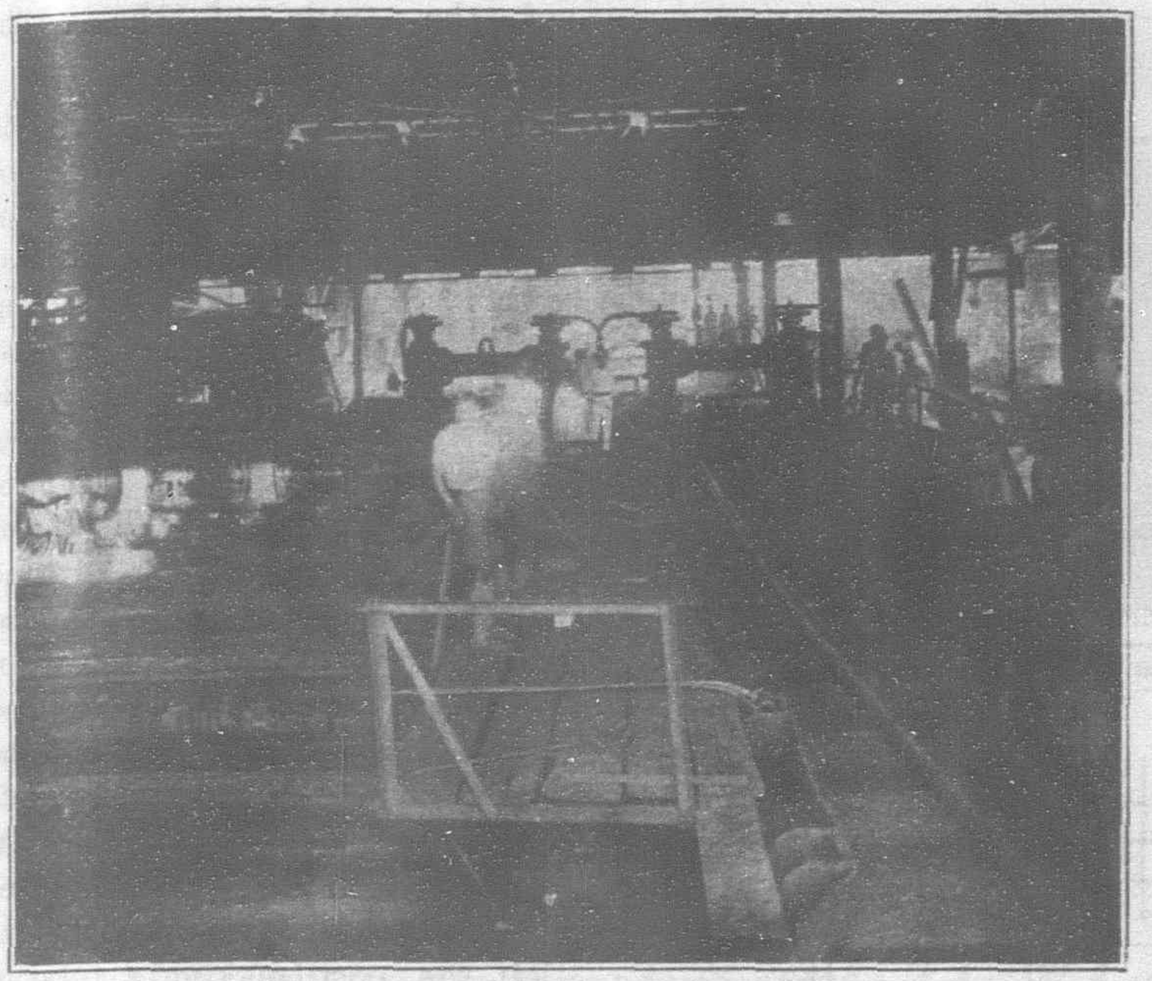
Machine Shop



Steel Works, Charging Side

Blast Furnace Case House, Interior View

Steel Works, Pouring Side



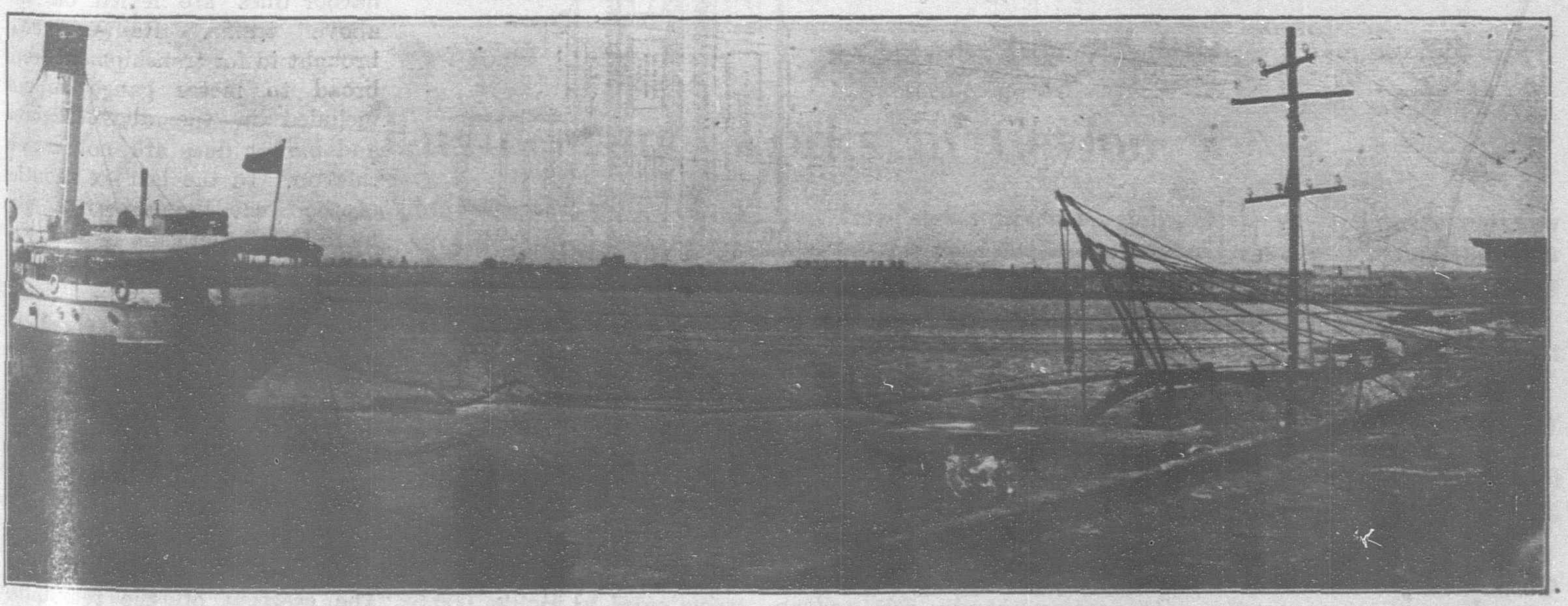
Tata Iron and Steel Works: Rail Mill

Tata Iron and Steel Works: Bar Mill

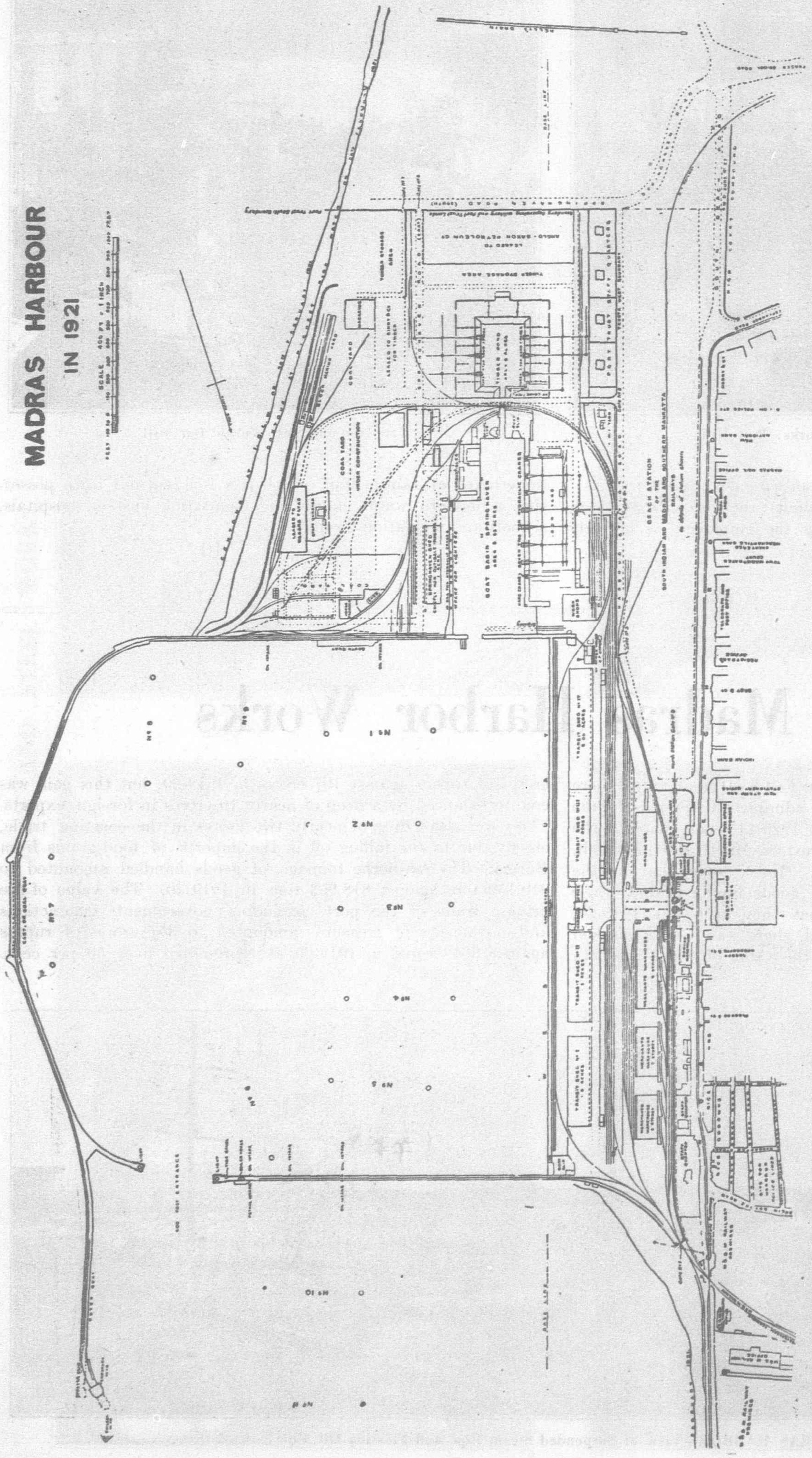
University, assisted by a staff of Indian wiremen and electricians." The coke-oven department is also under the sole charge of an Indian. Social welfare work among the employees is actively undertaken at Jamshedpur, which is a well-laid out town possessing a modern water supply and sanitation system, hospitals, schools and recreation grounds.

The Madras Harbor Works

IN the July 1921 issue of THE FAR EASTERN REVIEW there appeared a résumé of the administration report for the official year 1919/20. The 1920/21 report made by the chairman of the board of trustees, Mr. H. H. G. Mitchell, O.B.E., M.INST.C.E., M.I.E. (Ind.), says that in the past year the tonnage of goods handled and their value fell very little short of what they were in 1919-20, the record year. As was anticipated, there was a very marked revival in the foreign import trade, the value of which was 21½ crores of rupees against 10¾ crores in 1919-20, but this gain was counterbalanced by a drop of nearly 10 crores in foreign exports. There was also a drop of nearly two crores in the coasting trade, chiefly due to the falling off in the imports of food-grains from Burma. The sea-borne tonnage of goods handled amounted to 810,159 tons against 818,993 tons in 1919-20. The value of the private trade of the port, excluding government transactions and movements of treasure, amounted to 35½ crores of rupees against 36½ crores in 1919-20; it represented over 50 per cent.



MADRAS HARBOR—View of Suspended Steam Pipe and Floating Oil Pipe



of the trade of the whole presidency.

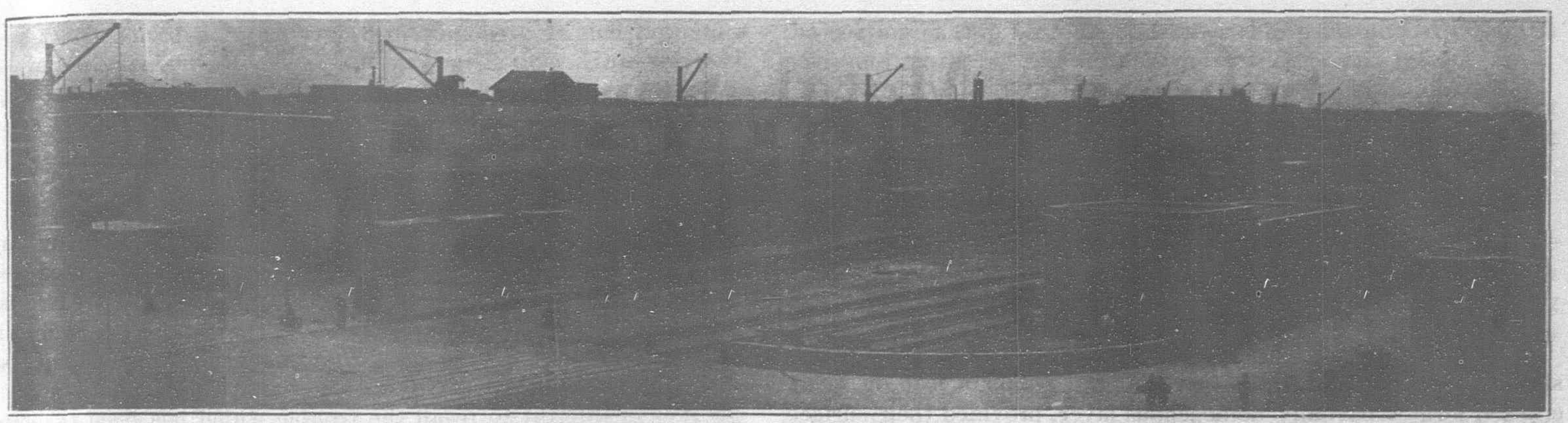
During the year 648 vessels with an aggregate tonnage of 1,662,444 tons, including 351 from foreign ports, 171 from coast ports and 103 country sailing craft, called at the port against last year's figure of 521 vessels of 1,166,352 tons. Several new lines made Madras a port of call, notably those trading direct with America. The vessel of the greatest tonnage which entered the port was s.s. *Khyber* of Liverpool of 9,014 tons and 5,685 tons net register, and the vessel with the deepest draft was s.s. *Morvada* drawing 29-ft. 6-in. Passengers to the number of 72,720 arrived at and 83,801 left the port making a total of 156,521. Out of 545 steamers that used the port 293 used the quays for landing cargo, passengers, horses, etc., 34 used the north and south oil berths for discharging oil, 5 used the outside berths for landing explosives and combustibles and 9 anchored in the fair way.

Tonnage Handled.—The total tonnage of goods which passed through the port in 1920-21 amounted to 848,756 against 940,564 in 1919-20, imports contributing 717,740 tons and exports 131,016 tons against 781,263 and 159,301 tons respectively in 1919-20. Of the above total, 810,159 tons was sea-borne against 818,993 tons 1919-20.

The difference between the total traffic and the amount sea-borne consists almost entirely of rail-borne coal brought in for bunkers and coal for transhipment from broad to metre gauge, harbor dues are levied on the above traffic. Railway coal brought in for transhipment from broad to metre gauge is not included in the above figures and harbor dues are not levied thereon. In the last six months of the year the import of coal by rail has practically ceased.

Engineering.

Cyclone Damage Works.—During the year the steel caisson, weighing 240 tons, filled with concrete, forming the head of the rebuilt portion of the sheltering arm, was sunk. The first 25-ft. of steel work, weighing 142 tons, was erected on the Port Trust slipway and launched in June. The erection of the remaining 30-ft. was carried out afloat,

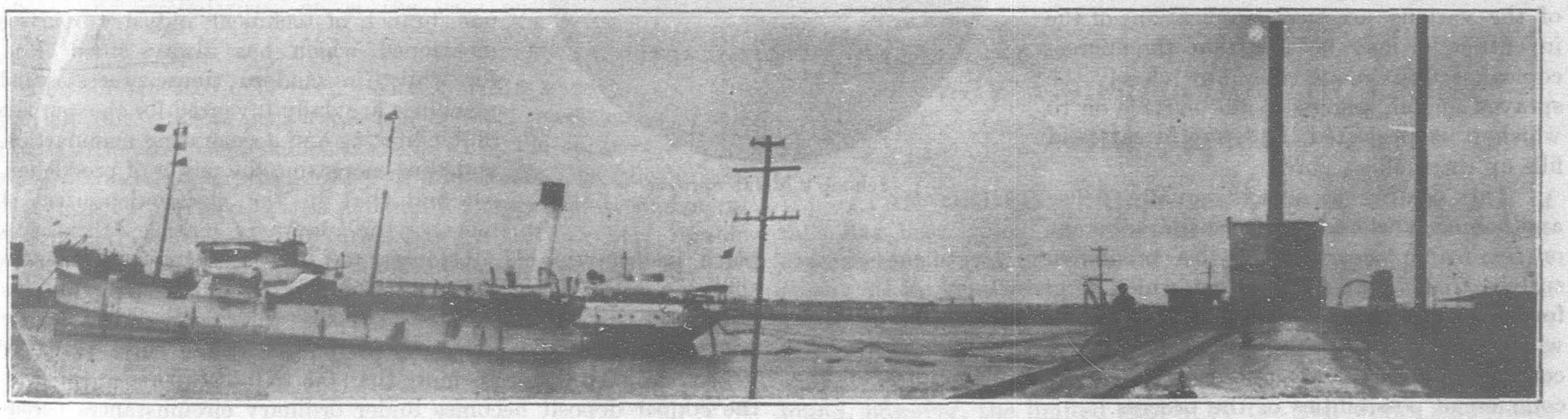


MADRAS HARBOR—Range of Newly Completed Warehouse

and completed by the end of September by which time, with the addition of 530 tons of concrete, she was drawing 26-ft. The finished caisson was then flooded and kept on the bottom, in the north-east corner of the harbor, during the November cyclone season. In January, she was refloated and towed out under lee of the sheltering arm where a further 610 tons of concrete were filled into her. This load brought her draft down to 36.5-ft.

Early in February 1921 she was placed in position in 40-ft. of water. Three days later unexpected bad weather set in and she started to move and worked herself into the bottom. After all attempts to steady her had failed, she was finally floated out to save her from being lost altogether. Additional freeboard was provided by adding two extra 4-ft. strakes and the sea bed at the site was hardened with broken stone and levelled off. Five weeks later, on 12th March, 1921, a second attempt to place her in position was made and proved successful. The remainder of the concrete filling was then put in, and by the end of March, 4,048 tons had been deposited in her. Five slices of block work measuring 30-ft. had to be put in temporarily in advance of the semi-permanent head to enable the Titan crane to plumb the well of the caisson for grabbing. These slices will be taken out and rebedded after the caisson has been sunk to her final level.

Cement.—Eight hundred and forty-eight tons of cement were purchased during the year. Of this quantity, 500 tons were obtained from England and the balance was bought locally, 250 tons being of local manufacture. 1,136 tons were used. The stock at the end of the year was 748 tons.



MADRAS HARBOR—Vessel Discharging with Steam Supplied from a Boiler on the Groyne

Engineering Works in Ceylon

THE first steam-roller manufactured in Ceylon has been at work for six months. Colombo government factory, where it was made, has now undertaken the construction of six similar machines. Their cost is about half of that of the imported article, and they suit local conditions better. The only portions not made locally are the cast steel gearing and cylinder lubricators.

During the war a 3-ton steam wagon was made at the Colombo government factory. It has been at work for four years transporting road metal for the public works department in the Negombo district. The government has now authorized the building of two similar steam wagons. In this case also the cost, compared with that of the imported article, is very low.

A wind-mill made at the Colombo government factory last year is now at work pumping about 80,000 gallons of brine every 20 hours to the crystallizing tanks of the Elephant Pass government salt works.

Three steam-driven saw mills at the government factory saw about 600 tons of timber per annum for wagon building and other purposes. The sawdust feeds a 150 h.p. power plant made entirely at the government factory, and saves some Rs. 8,000 per annum.

At the government factory about 30 steam-rollers of different types are overhauled every year.

The machine-shops for handing bridge-work are equipped very fully with modern tools. Parts of a bridge with a span of 175-ft. are now being produced. The annual output of finished material from the workshops, principally for the public works department, totals about 2,600 tons.

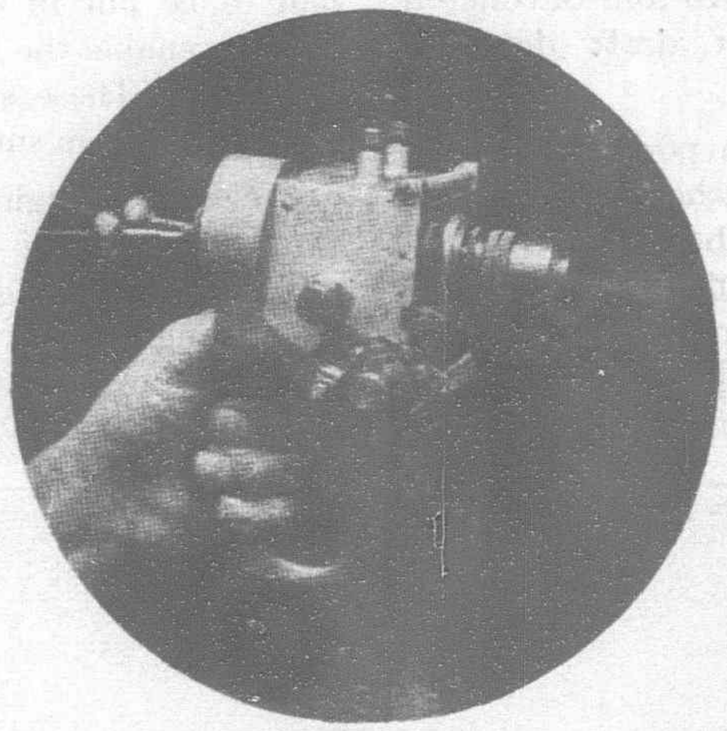
There are only a few engineering establishments at Colombo dealing with ship and motor repairs. Prospects in the engineering trade in Ceylon, considering the steadily-growing local and Indian demands, are considered good.

Schoop's Metal Spray Process

A Valuable Invention

DR. SCHOOP of Zurich, Switzerland, was watching his children with a Flobert rifle when he chanced to note that the bullets striking a wall were crushed thereon, producing a strongly adhering lead coating. This led him to make some experiments with small shot, which brought out the fact that the grains of lead on being crushed form a partially homogenous layer, provided their surface is cleansed and free from any trace of graphite. This observation led, through a number of more or less successful stages, to the processes which have now been technically developed to a high degree of perfection.

The apparatus consists of a vessel containing the metallic powder, or which the lower part can be closed by an ingeniously constructed valve with an irregular seating surface. Compressed gas, after being heated in a special heating device, is passed through the pipe into the upper part of the apparatus in order to force the powder out under pressure; the greater part of the gas from the same source, after having a rotary motion impared to it, acts on the powder expelled from the vessel and hurls it with great force through a nozzle and a metal tube on to the object to be coated.



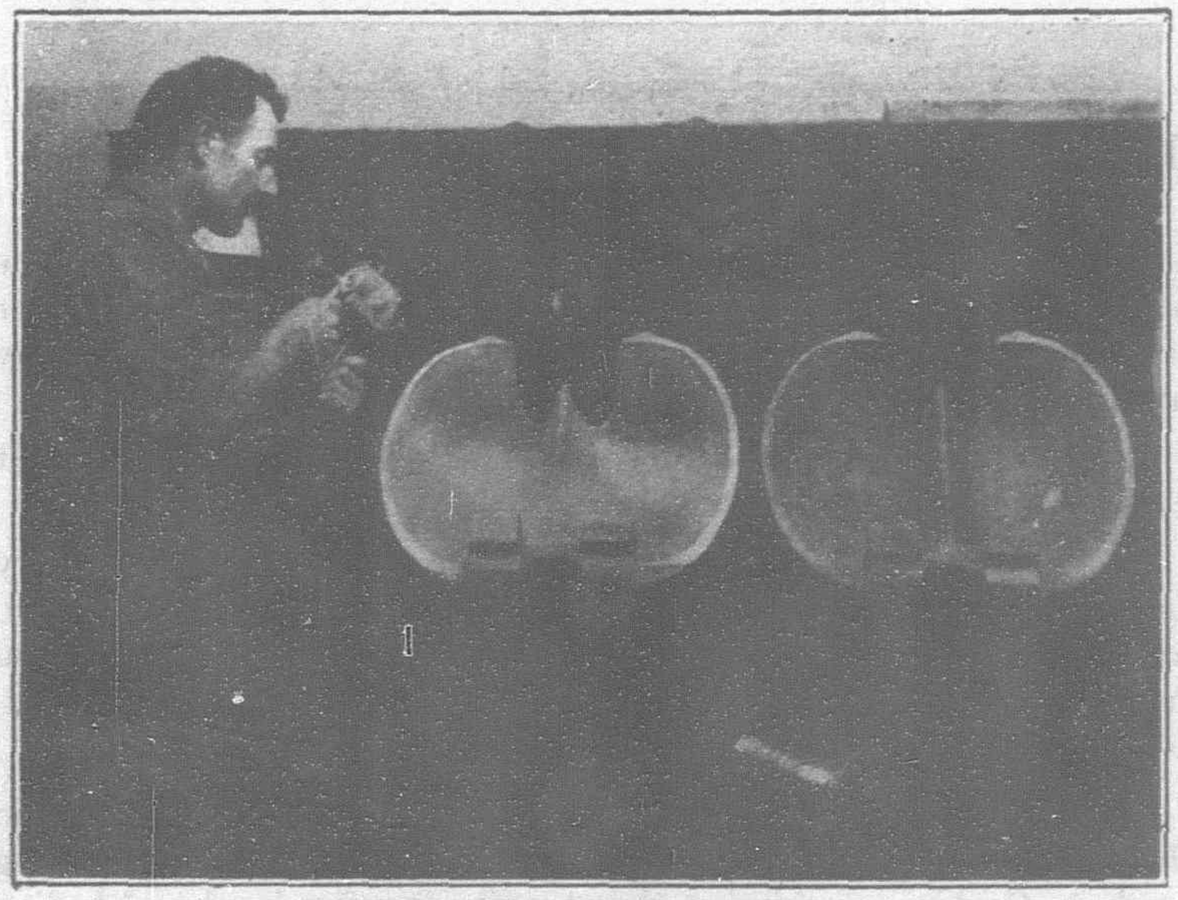
Schoop's Metal Sprayer

Before passing on to the consideration of the various practical applications of the invention, it may be said that the microscopical sections made show how closely the sprayed metal adhers to the surface on to which it is projected, and how it eats and fills up its smallest pores.

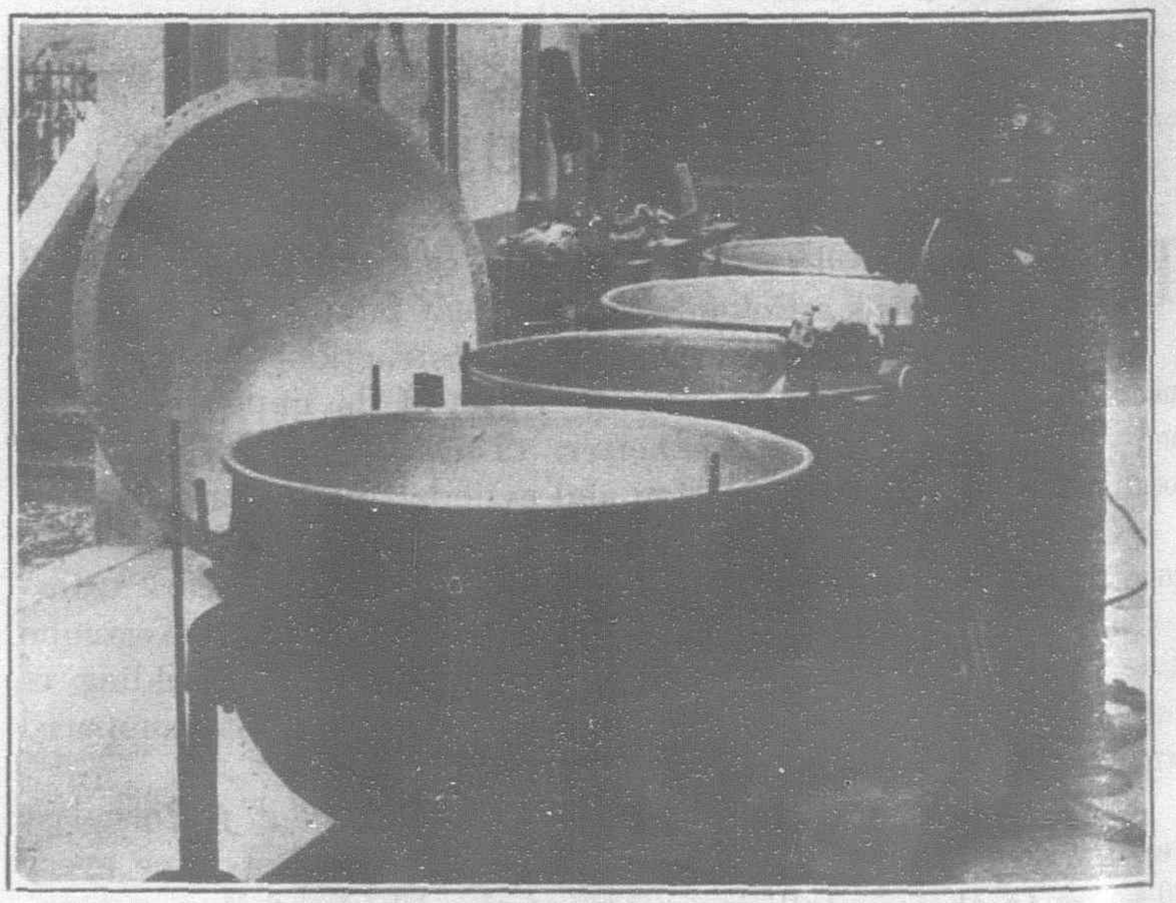
This coating is always equally dense and homogenous and can be made adherent or removable according to the preliminary treatment of the surface to be coated. The list which is given here of the uses for which the spraying process has already been employed, or in which it may possibly be used, cannot in any way claim to be complete, but is only intended to provide examples of the commercial possibilities of the process.

The first possibility is the application of the spraying process for coating objects with lead or zinc or the plating of the interior of vessels, vats, etc., for use in the chemical industry, in mines and many other works. Any vessel of partially any material or any part of an apparatus, which is difficult to get at, can be protected against rust. The process is of particular advantage where angular irregular bodies are concerned, and especially in eases where it is desired to cover large surfaces of finished constructional parts as a protection against rust.

It is of interest to recall the trouble which has been taken to obtain successful protection against rust in the cases of high structures which are exposed to the action of the weather, such as iron pridges, and the fact that of late years many bridges lave been built of armored concrete largely owing to the enormous exbenditure which the constant renewal of the paint of the iron bridges necessitated. If the finished parts of structural iron work are properly sprayed, there should be no further expense beyond the one initial outlay for a considerable time. There is ample opportunity of observing on many railways how very much such structures suffer under the action of the weather, in spite of the most careful painting. Again, in many railway stations, the iron structures are greatly damaged by smoke. The value of spraying process in this direction can be recognized at once. Before leaving the consideration of the heavier engineering branches one branch of technical industry must be mentioned which has always stood alone, for whilst in modern times processes and machines are daily invented for the purpose of facilitating and accelerating manufacture, and thus increasing the power of production, we find that in the electro-deposition of metals, the laws of nature themselves place insurmountable obstacles and the importance which the spraying process has in this connection is obvious. Theory teaches us that by galvanic means we can deposit with a current of I ampere not quite 1.2 gr. of copper in an hour. If the current density per sq. decimeter exceeds more than 0.3 to 0.5 amperes at the most the copper deposit becomes under ordinary circumstances porous or spongy. It is not, therefore, practical to deposit by ordinary methods more then about half a gr. of copper per hour, which forms a coating of 0.02 millimeter thickness. Of late years a

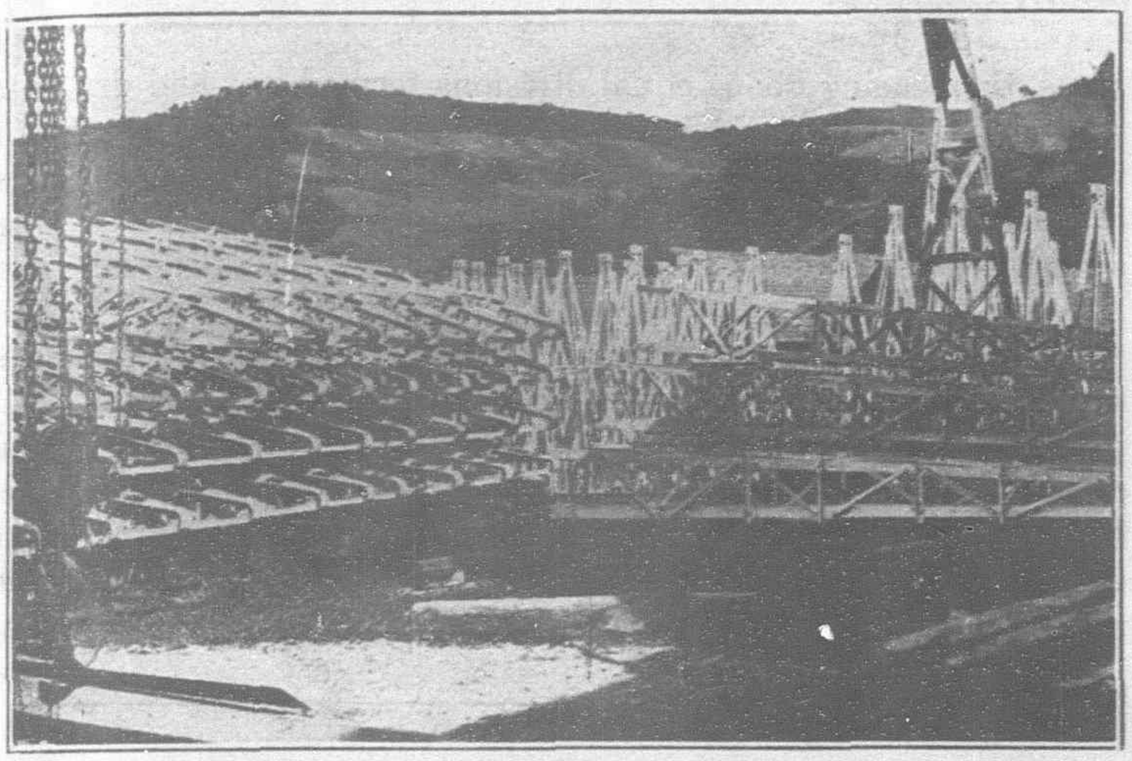


Spraying Water Turbine Blades



Coating Confectionery Boiling Vats.

firm has invented a rapid copper plating bath (which permits a deposition of about 40 gr. of copper per hour). However such cases are exceptional, for copper is the most suitable metal in the electroplating industry, whilst in the case of other metals all the most ingenious devices have not advanced far beyond the above



Transmission Towers and Spreaders for the Swiss Electric Railways Galvanized by the Schoop Process to Prevent Rusting

mentioned limited means. Further a deposit of even 40 gr. of metal per hour per sq. decimeter cannot be compared with the operation of the spraying process, which can deposit this quantity in a fraction of a minute, the deposition taking place with the same precision and the same close adherence of the metal to the smallest hollows and irregularities as is the case with electric deposition.

Metallic surfaces only need cleaning with a sand blast before spraying, and objects which do not conduct electricity do not require to be first rendered conductive since the sprayed coating can be produced on any material. In addition to this, the process offers the great advantage that it permits us to work the one metal which the art of electric deposition has up till now been unable in spite of all efforts to utilize : aluminium.

The possibilities of applications of the process for industrial purpose are, of course, quite unlimited, especially since the temperature of the metal spray is very low, so that not only combustible materials, such as wood and paper, but also substances which are actually highly infiammable, such as celluloid, and even explosives, can be directlysprayed. The-coating of fabrics with metal for airships, thus rendering them more gas tight whilst not appreciably increasing their weight by the thin metallic coating (which may be of aluminium), may provee of just as much importance as the coating of wooden frames and fabrics of aeroplanes for their protection against the weather and for increasing their stability. As a matter of fact, the coating of wood with metal is in itself virgin soil, and has many possibilities which are obvious. For example, the coating of ship bottoms and other ship parts and of telegraph poles and masts for protection against weather and insects.

The Inventor: Shoop

Packing cases, etc., can easily be strengthened by spraying the edges of the boxes for oversea transport. The task of soldering up a box containing dynamite must be a very unpleasant one, but it can be affected without danger by spraying process.

After what has been said it is unnecessary to reiterate the advantages which the applications of the spraying process offer in connection with artistic industrial works, for instance, coating wood, plaster, leather or celluloid objects wholly or partially with metal, or for producing patterns on surfaces by means of stencils. With regard to the taking of impressions of parts to the body, it may be mentioned that in Paris a successful attempt has been made to obtain finger-prints of criminals by the spraying process. Finally, in connection with this group of removable coatings, there is one branch in which the spraying processes are of the greatest importance, namely, the manufacture of casting and blocks. The spraying processes offer a most valuable substitue for all these methods since they are equal to them in accuracy and are superior to them in rapidity. For instance, it is possible to prepare in one hour from one single negative block as many as thirty finished blocks which are equal in every respect to electro-types. It is also possible to make blocks of iron and even of steel ; formerly these could only be produced by means of highly complicated engraving processes on a steel plate.

In all probability the Schoop spraying processes will constitute a great advance in not a few branches of technical industry and amongst these branches are some for which it will create an entirely new history.

Railway Construction in China and Japan

JAPAN ORDERS RAILS.—An order for 13,000 tons of rails has been given an American corporation by the railway department. Although different according to year, the annual consumption of rails by the government railways is 55,000 tons on average, of which the larger portion is supplied by the government Iron Works, whose yearly capacity is about 40,000 tons of rails minus supplies to private railways. The railway department found, however, the limited supply by the iron works inadequate for its needs this fiscal year, which have been increased somewhat over usual requirements. This compelled it to give the above order to the American firm on December 26, including 60 and 75-lbs. rails for arrival at Otaru, Yokohama and Kobe until March 31. The contract prices are kept sceret, but are conjectured by some to be in the neighborhood of Y.110 per ton, which is Y.10 or 15 lower than the Japanese products, which are stated, further, to be inferior in quality.

LIGHT RAILWAY, ANHWEI.—The Woo Shun Coal Mining Company at Pei-lee-ching in Shih-hsien, Anhwei, will build a light railway from the mines to Ma-dao-ching, a distance of 25 *li*.

CHUKIANG-HSIENTU RAILWAY, HUPEH.—The building of a railway from Chu-kiang to Hsientu, western Hupeh, is projected by the local gentry to develop the rich mines in these districts.

BRIDGES OVER YANGTZE RIVER.—Dr. Waddell has recommended to the Peking government the construction of three large bridges at an estimated cost of $70,000.000 :—(1) The Han-kiang bridge over the Han-kiang connecting Hankow with Hanyang; (2) the Yangtze bridge over the Yangtze River connecting Wuchang with Hankow; (3) the Yangtze bridge over the Yangtze River connecting Nanking with Pukow.

The Sugar Industry of the Fiji Islands

The Problem of Indian Labor

By Thos. J. McMahon, F.R.G.S.

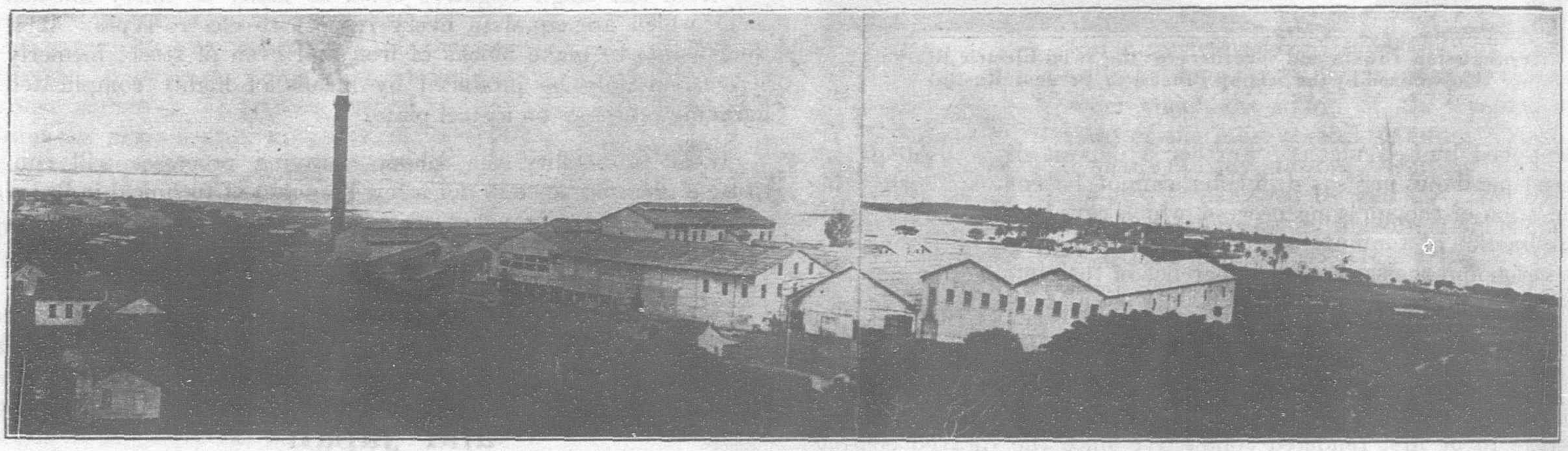
COMPARED with other island groups of the South Pacific, the Fiji islands have a claim to a wide and wonderful development. While there is much credit to be given to the skilful, business-like management of enterprises, and the splendid energies of the white settlers, the fact is very clear that the administration has been and is encouraging development. Undoubtedly a sane balance has been maintained by the administration in assisting trade and development, while fully protecting the interests of the native people.

Traveling through the group it is most impressive to see the vast areas under sugar cane, the number, size and modern equipment of sugar mills, the hundreds of miles of excellent light railways, the great solid steel bridges spanning the wide rivers, and Fiji has mighty rivers on its two big islands of Viti-levu, and Vanua-levu—the variety of motor traffic on harbors, rivers and roads, and the thousands of people in employment. To find a city of the size, and business importance of Suva, the capital is in itself a fine indication of progress. That picturesque city with its well-paved streets, avenued with splendid shade trees, with its liberal electric lighting, its ample water supply, and its long stretch of habor wharves, that can be considered as the best of the Southern Pacific territories. This city is at once the grandest evidence of the energies and enterprise of the settlers, the progressiveness of the administration. It would be impossible not to be especially impressed with the extent of settlement on every hand, and in all the bigger islands. Though the settlements of Indians, introduced to the islands 48 years ago are both mean and unpicturesque in appearance. The coast lines of the whole of the island territory is one unbroken chain of plantations, sugar, coconut, sisal, bananas, and other tropical products. There are on the rivers, and running to the hills great stretches of pastoral and dairying lands that cannot be excelled in quality even in Australia, or New Zealand. Indeed, summed up Fiji can be characterised as a land where marvellous things have been accomplished, a land which can be pronounced as one of magnificent fertility, and remarkable and varied resources.

Fiji consists of 250 islands, 90 of which are inhabited, with a total area of 7,500 square miles. The group lies in the tropics 176 east and 178 west longitude, and 15 and 20 degrees latitude. The two big islands Viti-levu and Vanua-levu, have exceedingly lofty ranges of mountains, and these have a most important bearing on the rainfall, which is heavy and frequent in the wet areas of the group, as well as saving from long continued drought the dry areas, there being about equal divisions termed wet and dry areas. The mountains too influence the climate of the islands, which is very moderate, and healthy, the death-rate of Fiji being the lowest in the wide world. White men and women 70 to 90 years of age are to be met in the islands, many of whom have lived there for 50 years and over.

The populations of the group are 4,000 whites, 85,000 natives, 61,000 Indians, 3,000 Chinese, and 3,500 half-castes.

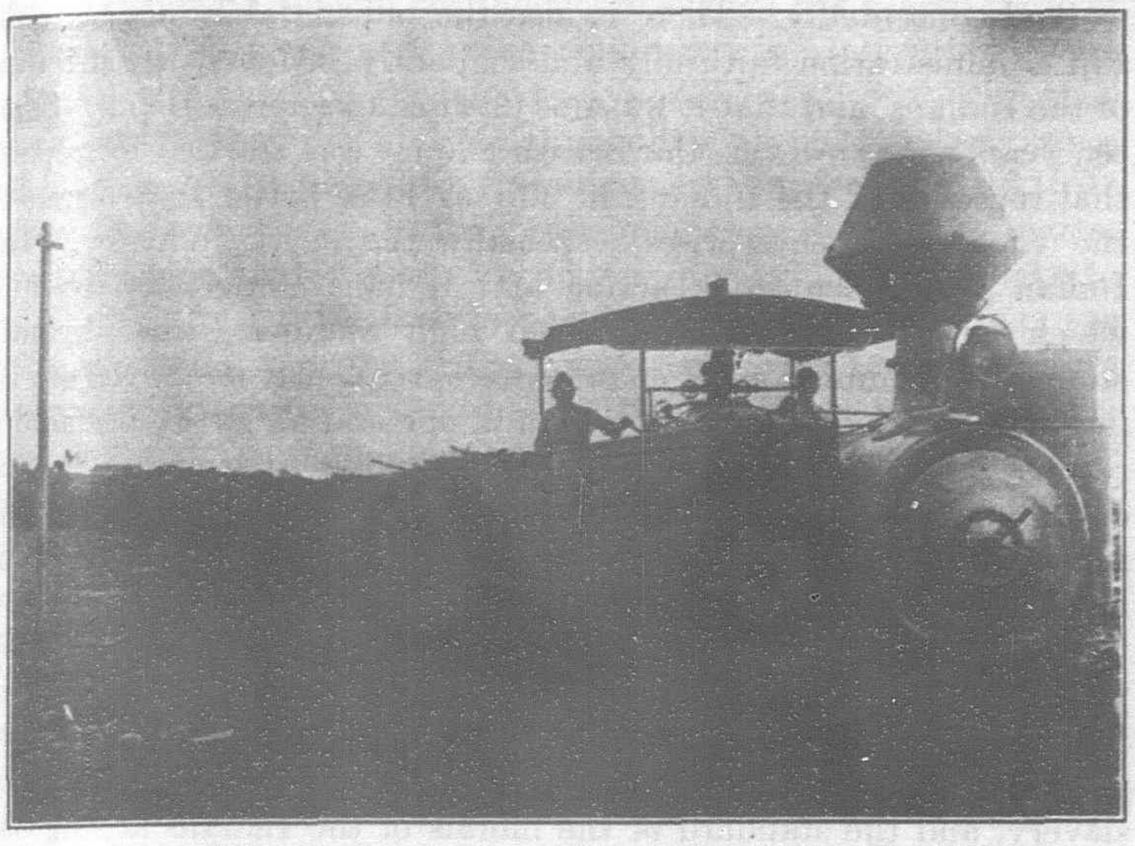
The trade of Fiji is now equal to 16 million (or 4½ million British money) dollars a year, but given an era of progress, unhampered by industrial unrest, and then a wide extension of development, the trade of the group should easily be in ten years equal to 100 million dollars a year. An important detail in the future prosperity of Fiji is the influence of the Panama Canal, this now gives Fiji a very definite central position in the South Pacific. Further there is the possibility of a federation of all British administered islands of the South Seas, with Fiji as the governing centre, should this eventuate and it is very likely within the next year or two, then Suva will become one of the three most important shipping centres of the Southern Hemisphere, Sydney, Australia and Auckland, New Zealand the others. There is the fact that the island's trade once altogether Australian, is now quickly drifting to Suva.



The Colonial Sugar Company's "Lautoka" Mill in the Fiji Islands

As a commercial asset the sugar industry of Fiji is worth many millions sterling. The group has sugar lands that compare most favorably with the best of all other sugar countries. In an estimate computed some years ago and taken from an old sugar journal, it stated that some countries produced five tons of sugar to the acre, and Fiji but three. Out of the 150 thousands of acres cultivated in Fiji to-day 85 per cent. of thc acres can under experienced cultivation offer from four to five tons. Fiji lands too have up to date shown an extraordinary fertility, and vigor, and beyond the cane ash from the mills no other fertilizer is used Fiji is recognized as one of the most valuable territories under the British crown, and on account of its wonderful sugar industry possibilities. The amount of sugar exported from Fiji in 1921 was less than other years on account of strikes by the Indian workers, nevertheless, it ran up to figures nearing 80,000 tons. Having comfortable labor conditions—the seasons can be depended upon the output of sugar this year should be about 100,000 tons, in another decade with reasonable conditions and a wider sugar cane area the supply should reach 200,000 tons.

Sugar companies in Fiji have shown both courage and enterprise. There are some three companies, the Colonial Sugar Company, the Vancouver-Fiji Company, and the Melbourne Trust

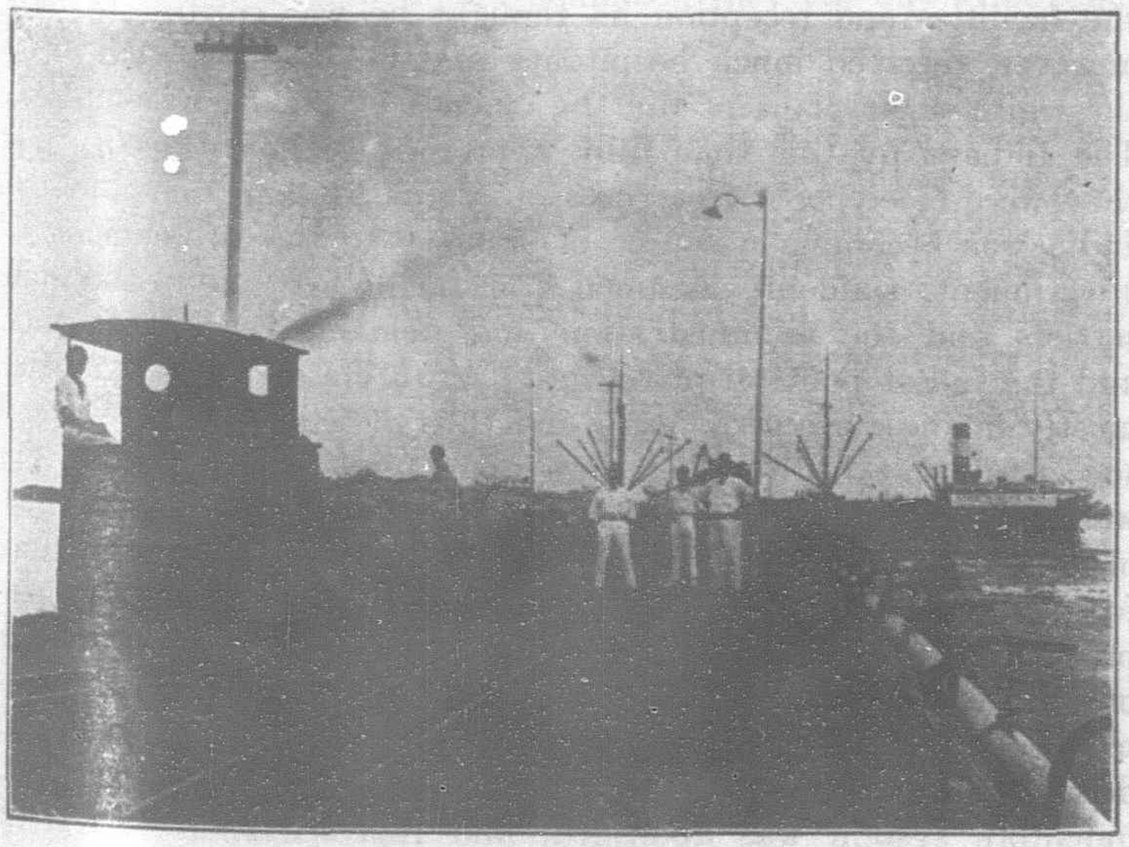


Sugar Cane Train on the Lautoka Plantation, Fiji. The Colonial Sugar Company operates over 200 miles of plantation railways in Fiji

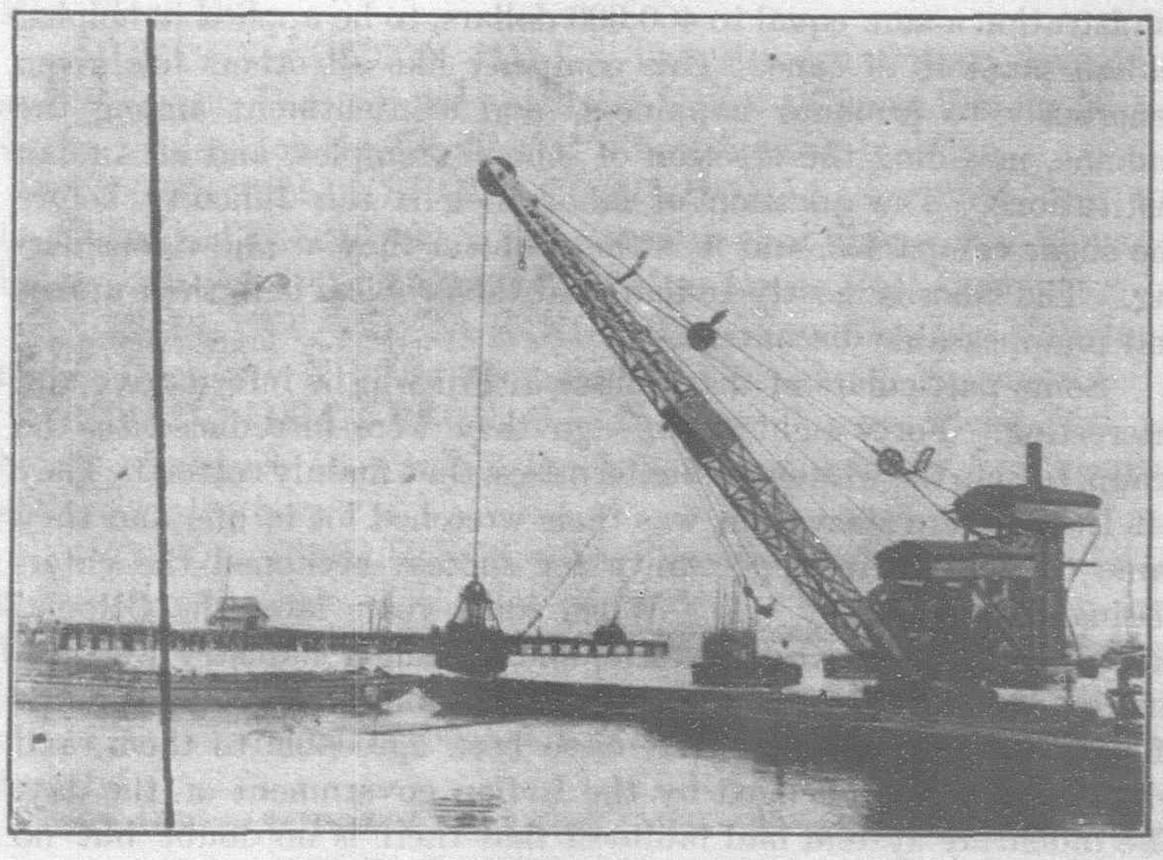
In the yard of the Vancouver-Fiji Sugar Company's Mill on the Navua River, Fiji

Collecting Burnt Cane, Uandi District, Fiji

Laying Portable Tracks into the Cane Fields, Fiji



The Wharf of the Lautoka Mill, Fiji, showing Molasses Pipes and a 7,000 tanker being loaded with Molasses

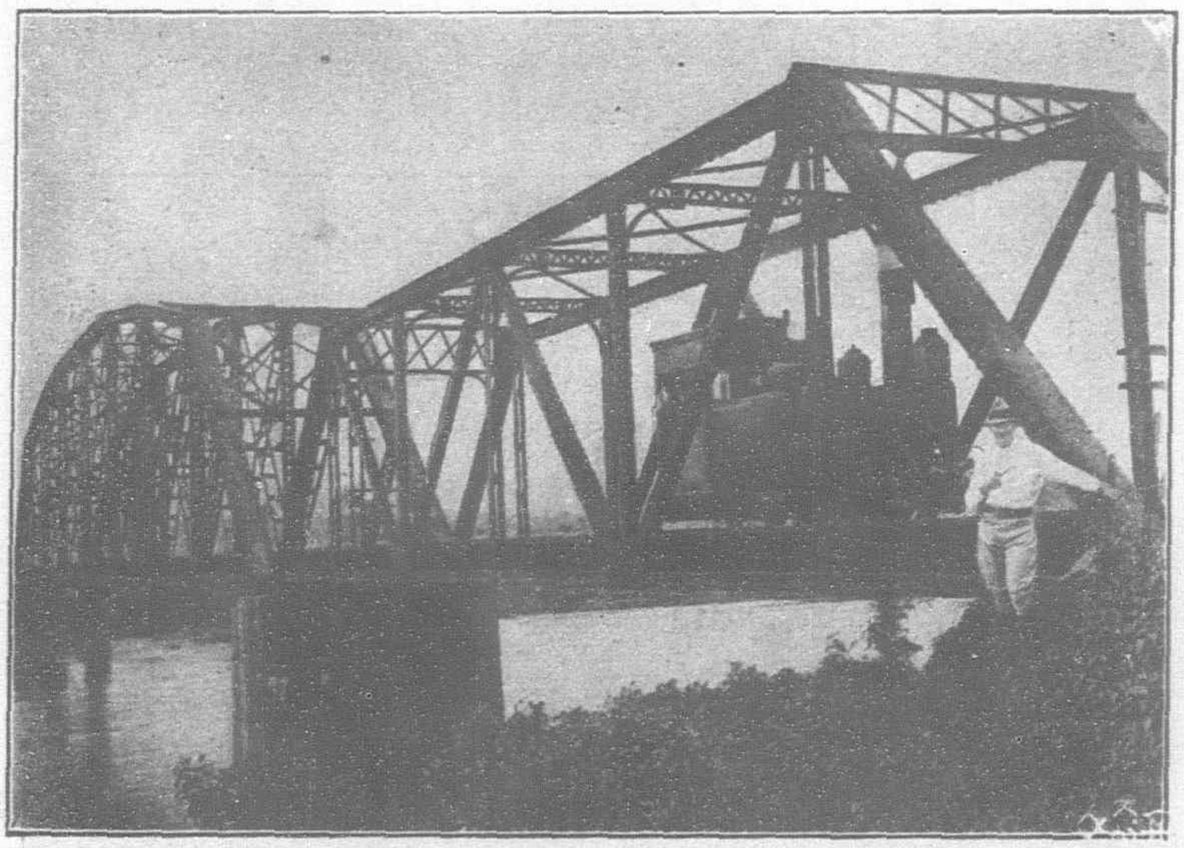


Reclamation Work in Suva Harbor, Fiji. All the foreshore is being reclamed for building sites

Company. The Colonial Company is a giant concern with its head offices in Sydney, Australia, and besides many ten of thousands of sugar cane acres has mills at Lautoka, Ba, Nausori, and Labasa. The Lautoka mill opened in 1903 is reckoned one of the most up-to-date, and complete in the world, with a capacity of 40,000 tons. The Vancouver-Fiji Company has a fine mill on the Navua river, with a producing power of 10,000 tons. The Melbourne Company is on the north of the island of Viti-levu, and is of a smaller capacity.

At one time there were several small mills dotted over the sugar areas, but present-day experience is for big capacity mills serving large areas, and fed by railways. The fluctuating price of sugar in the markets of the world makes it very evident that in order to attain success manufacturing of sugar must be conducted on large scale, large mills and large areas, small mills, and small areas these days cannot be made profitable.

While all companies may claim capable organization, the Colonial Sugar Company stands out as a master organization, it is one of the surest foundations for the continuance of progress in Fiji. From the smallest beginnings it has spread itself out a vast enterprise employing thousands of people, white, and black, and expending millions of money in outlay in mills, lands, and the settlements



Bridge over the Navua River for the Plantation Railway of the Vancouver-Fiji Sugar Co.

Wives of Indian laborers employed by the Fiji Sugar Companies. Women and children wear necklaces of 25 to 50 gold Sovereigns

of its employees. It has a fine record of able management, of successful business, and above all of fair and liberal treatment of its workers. But in this last essential no company has received more unfair treatment from its Indian workers than the Colonial Sugar Company. No company has been more active in helping the Indians. Recently it placed at the disposal of the Fiji administration a sum equal to 400,000 dollars, to be applied in helping Indian planters of cane. This company like all others has given generously to promote happiness, and contentment among the Indians, in aiding the erection of schools, temples, and all Indian institutions. The question of labor then is the difficulty before the sugar companies, and it is the problem they are now considering. The labor is mostly Indian, and the problem is in their unrest and unappeasable discontent.

Some particulars of the Indians in Fiji will be informative and interesting. Forty-eight years ago they were introduced to the group, to help the whiteman's enterprises, then mainly cotton. They left India where starvation was their wretched lot in life, and they came to Fiji where opportunity for success beckoned the enterprising man on every side. When some years later the Colonial Sugar Company began its efforts, and the sugar industry was getting a firm footing, thousands of Indians came to Fiji under terms of indenture, terms that must have been agreeable to them, and which were not challenged by the Indian government of the day. The indenture system had faults of that there is no doubt but no reliable records show that the system conduced to callous treatment, or even harshness of the Indians employed. And there is the substantial proof of this that for over 30 years the Indians worked contentedly. There is also the indisputable fact that the Fiji administration faithfully and vigilantly watched the interests of the Indians, and that it was not possible to oppress them. Some ten years ago, however, the British empire was startled by reports that represented the Indians in Fiji as little better than slaves to the whiteman's enterprises, especially the sugar industry. The Indian government took action and Indian immigration to Fiji, which strange to say, maintained high numbers, was abruptly stopped. Commissions of enquiry were frequently employed studying the conditions of the Indians, and one and all gave satisfactory reports, all being unanimous in the opinion, "that under no circumstances could the Indians have been better off in India." The reports have now long since been amply proved as the insane imaginings of Mr. Ghandi and his party. An English missionary of the name of Andrews, and a man who have lived in India for many years, visited Fiji and reported the condition of the Indians as most favorable. A second time he visited Fiji, and then to the amazement of all pronounced the indenture system as the worst form of slavery, and the standard of the morals of the Indians arising out of the callousness of the system to be lower than the poultry yard.

Mr. Andrews directed his charges mainly against the Colonial Sugar Company as the biggest employer of Indian labor. Andrews charges immediately brought the administration and the white settlers to an united action and the result was the charges were shown to be pure exaggerations, founded in pique, Andrews not having any official authority for his investigation did not receive the facilities and reception he thought he was entitled to. He, however, received much hospitality and kindness especially from the white sugar planters and the officials of the sugar companies. The Indians by this time fully appreciating the knowledge that they were receiving a great deal of sympathy, and that unrest in India was becoming a source of anxiety to the British imperial government, suddenly assumed a menacing attitude to the white settlers and the administration and demanded racial equality, and the fullest political priveleges. Agitators arrived from India, mostly in the guise of religion, and their efforts were so quick and successful that before they were found out, the Indians of Fiji were rebellious, they were deliberately aiming for the overthrow of British rule, and the ousting of the whiteman. Strikes lasting for months were used to block and destroy the whiteman's enterprises. Failing in this to the extent they hoped for they broke out in riots notable for bitterness and savagery. Then firm administrative action was taken, troops were brought from a British dominion, and Indian ambitions for supremacy in Fiji were ended. indentore system was abolished, and representation was given the Indians in the Fiji general parliament. But these palliatives had not the effects expected. The morals of the Indians remained

as low as ever, crimes with them were as frequent as ever, and these conditions remain though the indenture system has ceased for over two years. All wage and living conditions in enterprises were improved with them in the hope they would be satisfied. But they remain sullen, they demand racial equality, all political privileges, and the sugar workers ask for 2 shillings an hour, equal to 16 to 18 shillings a day's work. In their sullenness they decided no matter what happened they would as a matter of religion call a strike to last six months. With fanatic perseverance they carried out the strike, the sugar industry suffered a set-back, but the Indians are at the moment realizing they have made a terrible mistake. The sugar industry is employing hundreds of Fijian natives in their place who are proving willing and capable. Then there is afoot an agitation to repatriate the Indians and get there reliable Chinese in their place. The sugar companies too are showing an independence the Indians little expected. One sugar company has given notice its mill will close until the high price of cane demanded by Indian planters is reduced, and the wages asked by Indian workers are brought within those reasonable limits leaving some margin of profit for the company. All other sugar companies threaten to follow suit, and the Indians are confronted with the proposition of being repatriated to India, back to starvation and misery. What will be the result one is not at present able to foretell, but this is very evident that if Chinese labor can be brought to Fiji, it will mean a new era of prosperity for the group. The majority of the white settlers will be glad to see the end of the Indians, whose unreasonableness is beyond all comprehension.

What is so remarkable in all this turmoil is the prosperity of the Indians. The following details will be enlightening as showing how well the Indians have done in Fiji. Some of the richest men of Fiji are Indians, some sprang from the ranks of the indentured labor. Every Indian settlement of Fiji is notable for its ever-increasing population, these settlements are crowded with children. There are 12,000 individual Indian land-owners in Fiji, owning 125,000 of the richest acres, and valued at £750,000. An interesting evidence of the wealth of the average Indian in Fiji is demonstrated in the jewelery worn by the women and children, and sometimes by men. It is quite a common thing to see gold and silver ornaments to the value of 400 dollars or more on a woman. Tiny children playing in the gutters sport necklaces of gold sovereigns, Australian currency. Every family owns its land, its cow, its horse and sulky. There are many motor cars in Fiji, and majority are Indian-owned. In five vessels leaving Fiji for India, between the end of 1920 and the beginning of 1921, there traveled 4,751 adults, and 1,960 children, mostly born in Fiji, having remittances equal to £196,389, jewelery equal to £31,891, and cash in hand £8,054. These are the people who going to India proclaim the territory a land of slavery. And yet these are the first, the moment they are robbed of their wealth, a frequent occurrence in India, friendless and penniless, they cry out to be sent back to Fiji.

What is one of the most remarkable admissions of the untruthfulness of reports of ill-treatment of Indians in Fiji is the fact that the Indian government has since last October permitted immigration to Fiji, and to-day the Indians are flocking to the group.

For the moment the future of Fiji is obscured in the problem of the Indians, but nothing is more assured that given reasonable conditions of labor, Fiji will soon be one of the most important commercial territories of the Southern Hemisphere. The factor that guarantees this prosperity is the continuance of the sugar industry.

Nantungchow Automobile Service

SINCE new motor roads has been completed in the various villages of Nantungchow, a company has been established to operate motor services.

CHANGSHA-NINGSHANG AUTOMOBILE ROAD.—Messrs. Tao Chung-chien and Liu Keh-chia have obtained sanction from the provincial government of Hunan to organize a company with a capital of $500,000 to build an automobile road from Changsha to Ningshang and operate autobus service there. Some Americans have proposed to construct a road starting from Changsha, passing through Yih-yang, An-hua, Sao-poo and Tze-kiang, thence to Hsiang-dan via Wu-kong, Pao-ching and Hsiang-hsuan and leading to the newly-built military road in Hunan, with a total length of 2,661 *li*, with "famine" labor. The work will cost $2,000,000, of which $1,200,000 will be appropriated by the Chinese and foreign famine relief committee and the balance raised from other sources. A number of Americans in Peking have supported the proposal and the U. S. minister is said to have approved the scheme.

AUTOBUS SERVICES IN SHANSI.—Up to the present, four automobile roads recently built in Shansi have been opened to traffic under the jurisdiction of the provincial road administrations, viz., the Taiyuanfu-Tanhsien line, in the north, the Taiyuanfu-Lingshih line in the south, the Taiyuanfu-Fenyang line in the west and the Taiyuanfu-Pingting line in the east. The Tsing Yih Autobus Service Company, Ltd., is being organized at Taiyuanfu, Shansi, by Mr. Sung Hai-hsu to operate an automobile service on the South Shansi road with six freight and four passenger cars. The Tsing Pei Autobus Service Company, Ltd., Taiyuen, Shansi, is raising capital in Fengyang for purchasing cars to operate on the roads leading to western Shansi.

YUNNAN-KWANGSI AUTOMOBILE TRANSPORTATION COMPANY.—The Yunnan-Kwangsi Automobile Transportation Company, Ltd., is being organized at Yunnanfu with a capital of $5,000,000 in 500,000 shares of $10 each. The motor road to be built by the proposed company is to start from Quan-yang, Yunnan, passing through Yu-chee, Kiang-chuen, Tung-hai, Kien-sui and Koo-ju, connecting with the Kooju-Pichaoshan Railway, thence to Pansuh, Kwangsi, via Wen-shan, Kwangnan and Po-yih. Three branch roads have been mapped out leading to Zih-wu, Shih-ping and Wen-shan respectively.

ANKING-LIUAN AUTOMOBILE ROAD.—An automobile road is to be built from Anking, Anhwei, to Liu-an, Anhwei, viâ Dungcheng and Wai-ning by Messrs. Wang Li-yuan, Sha Hsiangchang and Wang Shaio-shan in order to operate an autobus service. The actual work will be started in about two months when the capital is expected to be subscribed.

ROAD CONSTRUCTION, SOUTHERN KIANGSI.—It is reported that Mr. Chow Wei-kong, chairman of the road construction bureau of Kiangsi, has secured a loan of $3,000,000 from a foreign firm in Shanghai to construct the projected roads in southern Kiangsi.

Industrial Notes

MATCH FACTORY, KIRIN.—A match factory is to be established at Tungkwan, Kirin, by Mr. Sun, manager of the Hun Man Flour Mill.

MUKDEN COTTON MILL.—The Mukden Cotton Spinning and Weaving Factory promoted by General Chang Tso-lin is inviting tenders for the erection of a new factory building.

FLOUR MILL, SHONG-CHIU, HONAN.—A flour mill to be capitalized at $240,000, is being organized at Shong-chiu, Honan, by Mr. Liu Sze-kiu, manager of the Hun Foong Coal Company.

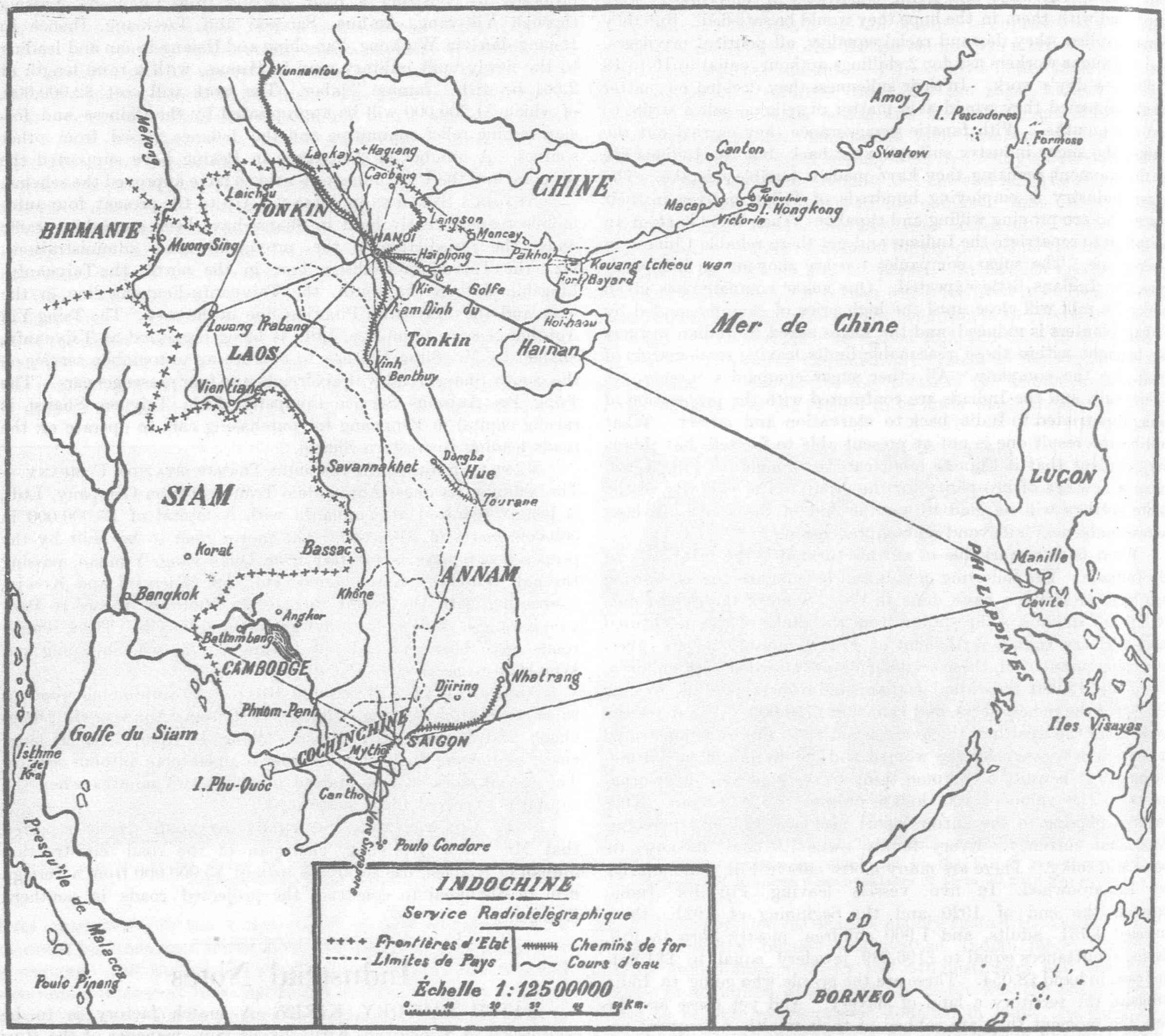
ICE PLANT, CHUNGKING.—The Woo Foo Ice Manufacturing Company is being promoted at Chungking, Szechuan.

FLOUR MILL, PAOTAO.—The Pao Foong Flour Mill is being organized at Paotao by ex-premier Chien Nun-hsiung and several others.

CANTON BUILDINGS.—The Canton authorities are contemplating the sale of the lot of land at Tung-kong-sing-hu for $700,000. Of this, $300,000 will be spent in erecting a magnificent town hall and a library, $200,000 for offices for the various departments and bureaus, $100,000 for a school, and $100,000 on a hospital.

GLASS FACTORY, NANCHANG.—A glass manufacturing company to be capitalized at $400,000 is being organized by Messrs. Li Shiao-chou and Wang Cheng-chien at Fu-kien, Kiangsi.

The Radio System of Indo-China



(*L'Eveil Economique de Indo-Chine*)

THE radio telegraphic system of Indo-China inaugurated under the administration of M. Sarraut and developed by his successor, Governor-General Long, consists of 15 stations, including the two at Cat-Ba and Kien-An, which are also equipped with special apparatus to facilitate navigation during heavy fogs at the entrance to the Haiphong River. The general system is divided into three secondary systems: (*a*) Tonkin system; (*b*) Laos system; Cochin-China system.

The Tonkin system comprises the following stations:—Hanoi, Kian-An, Cat-Ba, Moncay, Caobang, Hagiang and Laichau. From Kian-An or Moncay, communication is had with Fort Bayard at Kwangchow-wan, which is in communication with Hongkong. Moncay, Caobang, Hagiang and Laichou, all frontier posts, intercommunicate and connect with Hanoi and are able to give immediate notice of the movements of the pirate bands which infest the coasts or the bandits which flit back and forth over the Kwangsi border. Upon the coast station at Kian-An, in addition to its connection with Fort Bayard and ships at sea, devolves the duty of transmitting the standard time.

The Hanoi station of 25 kilowatts capacity is equipped with the best high-powered apparatus and communicates with Yunnanfu, Tourane, the Laos stations, and Saigon, and is to be enlarged for a rapid public service with Saigon. The coast station at Tourane is maintained for communication with vessels and to transmit the meteorological bulletins.

The Laos system has stations at Luang-Prabang and Vientianne which intercommunicate and connect with Hanoi. The Cochin-China system comprises the stations at Saigon, Mytho, Phuquoc and Poulo Condor. The Phu-tho station at Saigon which as yet is only a secondary station, but which is to be equipped as a first-class station within the year, now communicates with Hanoi and other countries through the station at Bangkok in Siam and through the Manila station with San Francisco. The Mytho coast station is in communication with ships and with Singapore and transmits the Havas News telegrams and the meteorological bulletins twice daily. A permanent service has been assured since July of last year between the three coast stations of Mytho, Tourane and Fort Bayard. Indo-China receives every night from the Bordeaux Central Wireless Station in France full market and exchange reports and the news of the day.

The Far Eastern Review

A Monthly Review of Far Eastern Trade, Finance and Engineering, Dedicated to the Industrial Development and advancement of Trade in Far Eastern Countries

ENGINEERING FINANCE COMMERCE

5 JINKEE ROAD, SHANGHAI CHINA

Telegraphic Address: Farview, Shanghai

SHANGHAI, MARCH, 1922.

Reaping the Whirlwind

ONCE again it devolves upon the responsible authorities of Shanghai to invite attention to dangers which menace the vital interests of the port. It will be recalled that in his last annual report on the trade of Shanghai, the commissioner of customs gave as a reason for the recent business panic the great influx of foreign firms during the preceding year whose inexperience and plunging precipitated the calamity. This, in turn, was due in large part to the irresponsible campaign carried on by over zealous "griffins" who rode into local popularity on the wave of anti-Japanese sentiment and capitalized this to the full in their agitation to induce new firms in the United States to open offices in Shanghai. In this cockpit of conflicting national interests, it is difficult at times for newspapers and other defenders of the public welfare to speak as plainly as they might had they only one national interest to cater to. Shanghai paid, and paid dearly for a propaganda that would never have been tolerated in a united community.

In the same manner as the ground was prepared for the last catastrophe so the way is now being prepared for a greater one through the irresponsible and reckless propaganda of bolshevists, student politicians and the activities of foreign organizers and sympathyzers. In the December number of THE FAR EASTERN REVIEW we reprinted extracts from a recent report of the U.S. department of labor on "Labor Unrest in China," which invited attention to the "precariousness of a situation aggravated by bolshevist propaganda."

"Sporadically, radical doctrine had crept into university lectures; but its penetration into Chinese industries was not definitely manifested until the ninth anniversary of the Chinese republic, October 10, 1920, when the bolshevik agents in Shanghai issued circulars informing their Chinese comrades: (1) That the Peking government, being in the hands of the capitalists, was oppressive to the masses; (2) that in bolshevism the workers would find the only object worth living for and (3) that the people of Russia had already achieved this object after three years' vigorous struggle. Quietly and steadily this force has been gaining a foothold in the rank and file of labor. In February 1921 the Chinese chargé d'affaires in Denmark, who was then well informed on the Russian situation, advised Peking of the broadcast propaganda of the Moscow society in Tientsin, Shanghai, Hankow and Canton. A few weeks later Peking residents were startled by motor cars flying a red flag with a star and the letters F.E.R. (Far Eastern Republic). Thereafter the Chinese government felt it necessary to take precautions against lectures on communism and *pseudo* welfare speeches delivered at mining camps and industrial centres ostensibly for the benefit of the workers."

The business man, however, sees nothing and cares less about matters which does not affect his immediate prospects or profits. Under his very nose an agitation has been skilfully carried on under the cloak of Chinese patriotic uplift in some form or other, now as a protest against the proceedings of the peace conference at Paris, now as a national boycott against Japanese goods over the Shantung award, again as a protest against the Anglo-Japanese alliance and the menace of a boycott against British goods if the pact was renewed, in manifestations against the proceedings of the Washington conference, in the seamen's strike at Hongkong with its communistic tendencies and the perturbed labor conditions in Shanghai, with the possibility of further disorders arising from dissatisfaction over the results of the Pacific conference. It is all part of a set plan, the attempt to create a super-government in China, thats in the end will overturn the existing regimé and bring the agitator, into power.

When these agitators or their mouthpieces assume to stand for organized public opinion in China, the business man takes it all for granted. The foreign merchant in fact, the world at large, would be surprised to learn that the telegrams ostensibly emanating from Shanghai menacing the peace delegation at Paris and signed by at least a hundred chambers of commerce, guilds, student bodies and peace societies, were written in Peking and mailed to Shanghai to be there placed on the cable in order that the Shanghai date line would give weight and verisimilitude to the formidable array of signatory senders.

We recall one of these cablegrams which made a most profound impression upon the Chinese delegates in Paris and on the delegates and journalists of other nations to whom its contents were disclosed. It read:

Loutsenghsiang, Kooweichun, Wuchaochu, Wangchengting, Chinese Delegation, Paris.

"People of China rising to true representation through their merchants associations, students federations, guilds and organizations of all classes of citizens, have voiced entire nation's disapproval of transfer of Germany's former rights in Shantung to Japan. Signature of peace treaty without reserved understanding that subsequent questions of Germany's former rights or of Japan's succession to such rights in Shantung will be decided according to principles of international law and equity, will not be recognized as binding upon Chinese people. If such reservation is not formally acknowledged by other powers, treaty must not be signed. Any action contrary to these instructions will force people to repudiate delegations signature as unrepresentative and to hold delegation and government responsible for inevitable loss of national rights. Resignation of delegates at this time will be considered as evasion of responsibility." Signed by United Chambers of Commerce, 38 Students' Federations, 25 Educational Associations, 23 Christian Societies, 4 Returned-Student's Unions, Bankers, Silk, Tea, Linen and Laborers' Guilds, 3 Peace Societies.

Is it any wonder that in face of such a telegram that the Chinese delegates to the Paris conference refused to sign the peace treaty without reservations, or that they were so long a time returning to China? Is it any wonder that the American delegates and others who were permitted to read these instructions were impressed with the growth of public opinion in China and feared to go contrary to it?

The success of this experiment in creating a super-government through the medium of the press and the free use of the cable, convinced its authors how easy it would be to repeat it whenever the occasion required, and we find the same tactics resorted in the summer of last year by holding out the menace of a boycott against British goods if the alliance with Japan was renewed. Telegrams bearing the signatures of chambers of commerce, students' associations and other Chinese bodies were dispatched broadcast to members of parliament, the British cabinet and to prominent personages and bodies in America, all carrying the veiled threat of what would happen unless the demands of China were complied with. It also went over. It was anti-Japanese, therefore popular.

It was all so easy. The success attending the first attempt to wield the weapon of a manufactured public opinion resulted in its revival in order to prevent the renewal of the Anglo-Japanese alliance. Telegrams signed by eighteen guilds and students bodies were dispatched to the British parliament and cabinet protesting against the alliance and conveying the threat that unless China's demands were complied with, a boycott would be declared against British goods. It was the same old trick, employed in the same old way, by the same minds that engineered the anti-Japanese campaign at the time of the Paris conference.

Unchecked, unhampered, emboldened by success, the system of intimidation spread. The Hindoos learned well the lesson taught them by the passive resistance of the Chinese, and unless all reports that come to us are exaggerated, the British have paid the price in India for the example set in China. They have paid

the price in Hongkong, and unless signs fail, we may dance to the tune of the red piper in Shanghai unless a saner view is taken of these recurrent political agitations.

Is the picture overdrawn? Read the following extracts from the report of the police commissioner of Shanghai and draw conclusions:—

"The spirit of unrest, or of self-expression, noticeable during recent years continued during 1921. Various movements were in evidence; among them being the opposition to the licensing of rice shops in July, different agitations by street unions, objection to the raising of rents, meetings in connection with China's cause at the Washington conference, Chinese representation on the municipal council, activities of socialist extremists and strikes. Other matters of special public interest to which the police are giving attention include the new produce and stock exchanges and light weight copper coins.

"The reaction on the Chinese people brought about by disappointed hopes was seen in May 1919 when the decision concerning Shantung at the world peace conference led to a general strike in Shanghai, which lasted for three days, and was only settled through the central government dismissing three of its most prominent officials. Bearing in mind the serious consequence which the reaction produced for the central government on that occasion, propagandists of certain interested politicians have for some months past been filling the Chinese minds with accounts of the great things to be expected from the Washington conference.

"A danger exists that the people, forgetful of what transpired in the past, will once again permit themselves to be gulled by the activity of these propagandists. As early as last August these parties began the distribution of leaflets advocating the abolition of extraterritoriality. This propaganda was followed by meetings of local bodies at which resolutions dealing with various phases of China's alleged wrongs and desires were passed and telegraphed broadcast. The most recent meeting, at which about 6,000 people were present, took place on a piece of vacant ground near the Shanghai-Hangchow Railway Station on December 8 when it was suggested that telegrams be sent to the Chinese delegates demanding the cancellation of the twenty-one demands and the unconditional return to China of Tsingtao and other rights and concessions in Shantung. These proposals, however, were not put forward, as strong opposition was raised by a prominent member of the Hupeh reconstruction society, and the chairman of the national organizations union of China, who pressed for the inclusion of a demand for the non-recognition of the Peking delegates. The same resolutions, including this demand, were, however, brought up and passed at a second meeting held by some forty-five persons behind closed doors in the premises of the national Chinese students' union, and the telegrams were dispatched. Following upon this the entire student body and other societies announced their disapproval of the attempt to prejudice the position of the Peking delegates and have since emphasized their opposition by resigning from the national citizens diplomatic federation, the organization which had taken the lead in sending off the wires.

"The audiences at the several meetings held up to the end of the year in connection with the Washington conference consisted for the most part of youths, professional agitators and idlers. It would not be correct to assume that the resolutions passed at these meetings at any time represent the opinions of the Chinese people. In China, however, where the masses to a great extent are swayed by the few, this agitation may produce quite unexpected and dangerous results. It may revive (among the masses) that never extinct spark of anti-foreign feeling and cause an uncontrollable conflagration which will be fed by the usually untruthful and biassed propaganda which has been scattered broadcast by disgruntled politicians and others."

The police commissioner has given voice to a truth that no foreign newspaper in China or foreign press correspondent cared to dwell upon. "*It would not be correct to assume that the resolutions passed at these meetings at any time represent the opinions of the Chinese people.*" He then points the danger, the menace that has been growing under our nose for over two years. The police commissioner gives official corroboration to evidence that has been in our possession for a long time. The warning of the police commissioner will fall on deaf ears. There are too many national interests catering to the Chinese who tremble and fear for the goodwill of the guilds and other bodies whose names are so freely employed to give prestige to the agitators and their work. Any movement masquerading under the cloak of Chinese patriotism or uplift is safe from foreign condemnation or criticism.

The police commissioner of Shanghai is not an alarmist. The picture he paints is not unreal. The Chinese have been trained and led by foreigners in their manifestations against Japan and Great Britain. They have been encouraged to boycott Japanese goods, while highly placed foreigners have publicly advised their countrymen to hurry and skim the cream off the Chinese trade. They have been educated to strike, demonstrate, hold meetings, send out menacing telegrams to foreign governments and blackjack their official delegates into accepting their viewspoint under penalty of having their ancestral tombs desecrated. They have been taught to attack the foreigner in his vulnerable point, his pocket-book. The example has spread to India, to Hongkong.

The agitators have mobilized and manufactured Chinese public opinion through pressure on chambers of commerce, students associations and other bodies, and held the rod over foreign governments and conventions. Yet at no time have they faithfully represented the great mass of Chinese.

We have been solemnly told that Bolshevism could gain no foothold in China, that the peaceful, democratic, docile Chinese would reject the teachings of Lenin; anti-Japanese writers have frothed at the mouth in denouncing the unwillingness of Japan to evacuate Manchuria and Eastern Siberia because of her fear that the red terror would find its way into China and Korea. Well, the picture is before us. The strike at Hongkong bears all the earmarks of a communistic plot. The police commissioner of Shanghai whose business it is to ascertain the inside facts surrounding disturbances in the settlement, has spoken.

The police commissioner is right. The agitators and the propagandists have pulled the wool over the eyes of the foreign community in China and through their foreign press connections, have fooled the entire world. They have educated the Chinese proletariat, the masses of unthinking, easily-led workers, into dangerous ways. Having learned their lesson, we look may forward to the inevitable consequences. As we sow, so shall we reap.

The Craft Guilds of China

By Ta Chen, U.S. Gov't Department of Labor Report

THOUGH the labor union, being an importation from the West, is yet limited in scope and influence, the craft guild penetrates every important trade in the country. A correct understanding of this powerful organization may therefore be a long step toward comprehending the industrial background of modernized China.

Two instances will give in a nutshell the tremendous power of the guild organization, past and present. In 1883, a dispute about tea export at Hankow (Hupeh) became acute. The foreign traders accused the Chinese merchants of showing false samples. The Chinese made the countercharge that false weights had been used. Whereupon the foreigners decided to stop buying, and the Chinese accepted the challenge by stopping sales. The tea markets in London rose steadily, but no tea could be bought at Hankow, and no coolie would work for the foreign concerns. A strike had been declared by the guild, which both the merchants and the coolies obeyed most strictly. Consequently, the foreign traders lost an enormous amount of money in the export trade.

Though it has undergone material changes, as shown elsewhere in this paper, the guild of to-day is no less powerful. The salt merchants of the Yangtze valley, including the provinces of Anhuei, Kiangsi, Hupeh and Hunan, were in the past required to deposit money with the bureau of salt producing and transporting merchants. Instead of immediately paying the money to the producers, the bureau usually retained it indefinitely and deposited it in banks of questionable financial soundness to draw interest, thus causing great inconvenience both to the merchants and producers. After repeated protests, the bureau was abolished and a new one established in its place. On hearing of a proposed revival of the old bureau last August, the guild of the salt merchants immediately threatened a strike, which, had it not been prevented, would have cut off the salt supply of the whole Yangtze valley for some time.

Organization.—The craft guild varies with various trades and different cities. For brevity's sake, the tea guild of Hangchow (Chekiang) is here taken as a type. The manager is elected annually. With him are slso elected 12 committeemen, all of whom serve without pay. Each of the committeemen takes charge of the guild for one month, thus keeping the chairmanship in rotation. The executive secretary is the only paid officer in the organization. Finding that the rotation system, though basically democratic,

has worked to increase irresponsibility and division of powers, the tendency to-day is toward the concentration of executive control in a committee of three, to be responsible for the work of the guild the year round. In some guilds the number of salaried officers is also increased.

Any firm wishing to join the guild must pay an initiation fee of a certain sum, that of the Hangchow tea guild being $300. The member firm is then required to obey the regulations of the guild, some of which follow: (1) That no member firm is allowed to accept from or give to customers any rate other than the guild rate; (2) that no member firm is allowed, through underhand dealings, to cause loss to a fellow member firm and (3) that no member firm is allowed to antedate or postdate drafts. For any violation of these important rules, the firm is fined. In the case of defamatory acts of a more serious nature, a general meeting of all the guild members is called, and the guilty firm is, by vote, expelled from the organization.

Membership.—The firm is a corporate member of the guild. For ordinary guild meetings, each firm sends its representatives. The firm is composed of masters, journeymen and apprentices. The masters and journeymen are members of the guild, whose vote is required in such important matters as a common boycott. Though early initiation is possible, the apprentice becomes a member only after he has served his term of apprenticeship. The young craftsman is then a journeyman, and in that capacity he stays for two or three years. Professional courtesy and loyalty to his master impel him to serve first his master, with regular pay, before offering his services to others.

The masters and journeymen usually work in perfect harmony. Should there be friction, the journeymen hold meetings at a Chinese tea house and then make representations to the masters. As they are very helpful in the trade, their complaints receive careful consideration and are usually settled to their satisfaction.

More by custom than by guild laws, girls are prohibited from learning a trade. In the Bankers' Guild of Wuhu, this limitation is explicitly stipulated in the regulations. The only place where the girls are preferred is the needlemakers' guild. This is apparently due to women's aptitude for needle-eye drilling, an art requiring much precision and patience. To-day, however, girls have more trade opportunities, as shown by the fact that 56,000 woman employees practically monopolize the work of the silk-reeling industry in Shanghai.

Authority.—The craft guild is the unifying and controlling agency of a particular trade. Its word is law. It standardizes weights and measures. Keeping close watch of market changes, it issues a rate, usually daily, which must be accepted by all the members and the buying public. Rate-fixing power is given to the guild primarily to eliminate cut-throat competition by the members. When the guild system works normally, underbidding and underselling are not common, unless done in an underhanded way. Small merchants are not put out of business by unfair competition on the part of the more influential ones in the trade. The industry is thus stabilized.

Disputes arising between members are usually first referred to the guild for settlement, when the manager and the committee sit as judges, with two or three experts as advisers. In the early days, the failure to appeal first to the guild might result in the revocation of judicial protection to the member: "It is agreed that members having disputes about money matters and other important matters shall submit their case to arbitration at a guild meeting, where every effort will be made to arrive at a satisfactory settlement of the dispute. If it is impossible to arrive at an understanding, appeal may be made to the civil authorities, but if the complainant resorts to the court in the first instance without referring to the guild, he shall be publicly reprimanded, and in any future case he may bring to the guild, he will not be entitled to redress." To-day no such rigidity exists. The contestants are given the option of choosing between the court and the guild for the first appeal for settlement of any dispute. This change has come about mainly through the extension of governmental functions. In the past the government of China seemed to assume the *laissez-faire* attitude toward commerce and industry. After paying the taxes, the merchants were left entirely free. For the protection of their own interests, the guild undertook to formulate laws to regulate trade. In time, custom and tradition grew, and the craftsmen voluntarily submitted themselves to the jurisdiction of the guild. Of late, the state has promulgated trade acts and mining laws, and has employed experts to adjudicate industrial suits. Nowadays, the court as well as the guild may be appealed to as the tribunal of the first instance. But, owing to the craftsman's inability to pay the lawyer's fees and his aversion to legal technicalities, the guild is often preferred.

Income and expenditure.—The income of the craft guild comes from five main sources: (1) The initiation fee paid by the member firm at the time of joining the guild, as shown in the case of the Hangchow tea guild. (2) Donations by wealthy members. Twenty-five per cent. of the reserve fund of $850,000 is from private endowments. (3) Fines. The bankers' guild of Wuhu requires each member firm to deposit 100 taels as a guaranty fund against fines for violations of the guild rules by that firm. (4) Commission fee paid by firms from sales. The timber guild of Ningpo assesses its members according to the amount of their sales, averaging one-tenth of 1 per cent. on the turnover. (5) Fees from masters and journeymen. The Han Yang guild at Ichang provides that workmen, such as tailors' or carpenters' hands, pay 30 cash (about 13 cents gold) per month; their masters, if keeping no account books, are also assessed at the rate the guild sees fit; and clerks pay 2 per cent. per annum on their incomes.

Broadly stated, the income from the first three sources is for the permanent maintenance of the guild, and the income from the last two is for its current expenses. Other important items of the guild's expenditure cover the following: (1) The guild gives financial aid to sick members, and also to those who are temporarily unemployed. (2) The guild gives charity to the families of the poorer members. (3) The guild holds religious or social festivals several times a year. (4) The guild pays a government tax.

As above stated, the most important activities of the craft guild are threefold, relating to (1) the trade in general, (2) the member firms and (3) the masters, journeymen and apprentices. To illustrate its workings, the bristle guild of Shanghai is selected as an example. The bristle export of China for the year 1917 amounted to 64,181 piculs and 6,171,638 Haikwan taels. One of its largest member firms employs a manager, who receives a monthly salary of $100, an assistant manager who receives half that much, a chief foreman, who receives $30, and a number of foremen, who receive $20 each. The workers are paid by piecework, and are on a contract basis. They average about 35 to 50 cents a day. Twelve hours constitutes their workday.

The organization of this guild is one of the most up-to-date, and its regulations, of which the following are the main provisions, are typical:—

Both long and short bristle, if prepared by the ordinary method, shall be sold at the guild rate and no other. Bristles specially prepared or imported from other cities shall be sold at special rates to be fixed by the guild committee and the agent of the firm.

No member firm is allowed to accept from or give to customers any rate other than the guild rate.

Every master must, before commencing his work, purchase a certificate from the guild for $5. Masters from other cities, if in financial difficulties, may work for a month before purchasing the certificate.

Each master is allowed to take not more than one apprentice at any one time. After the completion of apprenticeship, the apprentice must work for the master as journeyman for at least two years before he himself takes in any apprentice.

The master shall be paid once in every 10 days. Fifteen cents are taken from every dollar to defray the current expenses of the guild.

There shall be a uniform system of weight, and that of the guild shall be adopted.

Drinking and gambling are prohibited.

All disputes arising between workers and employers shall be submitted to the guild for settlement. There shall be no strike pending a settlement.

The Craft Guild's Influence on Chinese Indutries

The honesty of the Chinese in business dealings has become proverbial among Americans. In a large measure, business honesty is developed in the guild organization. "One price" for one grade of goods must be strictly observed by all the members. A free exchange of promises between the promisor and the promisee, for a consideration, is always binding on both parties. The craftsmen, by mutual agreement, strive to turn out faultless work. Equity prevails, efficiency is obtained, and industries prosper.

Large-scale combination has protected the craftsmen and the coolies from oppression by the landed aristocrats and political demagogues. As early as the T'ang Dynasty (618-906), heavy taxation and the impressed labor act forced the poor to leave their homes secretly in order to evade the taxes, and in doing so they permanently lost their small holdings. Toward the end of the House of Sung (960-1279), vargrancy was phenomenally increased. In late years, the floating population has been an exploited class of manual laborers and skilled workers. The guild has acted as their fraternal protector. Even to-day some guilds pay about one-third of the court fees for the member who institutes a law suit and has a good cause of action.

In no small degree the guild has saved Chinese trade and labor from being crushed by the powerful foreign merchant. Facing a common competitor, the tradesmen and the coolies stand firm. Protesting against a grievance, the laboring classes unhesitatingly follow the decision of the guild. The foreigner has succeeded in exploiting China only by the incessant influx of capital, and the natives have maintained their industries largely through organization.

But here praise must stop. The guild, as a unifier, has greatly hindered freedom of action, and prevented the making of "industrial captains." A man of perspicacity and shrewdness finds little expression for business initiative. He is confronted with two alternatives: He must either blindly follow the guild regulations, or suffer a common boycott for exercising his creative intelligence and violating rules.

There has never been a national guild, the boundaries of the province limiting its furthermost development. Interprovincial competition by guilds has caused tremendous waste in production and retarded the growth of industries on national lines. The rice-milling industry is a favorite battlefield of the "Kwantung gang" against the "Hupeh gang" for capital and labor. Regional bias is carried to the extreme, and closer co-operation rendered impracticable.

Conclusion

The old and new phases of industrial life in China have here been sketched. The craft guilds have been efficient protectors of the skilled and unskilled workers from economic exploitation by capitalists and politicians. China is emerging from handicraft, and to-day the labor union is gaining ground. During this transitional period, various socio-economic factors have aroused the workers to strive for their rightful place in the industrial life of the country. This is clearly seen in the present unrest.

Finance China's Highways

The Way to Assist the Automotive Interests

AUTOMOBILE manufacturers are more and more turning their attention to the development of Far Eastern markets where the building of new roads, opening up virgen territory to commerce, offers a vast field for the sale of trucks and passenger cars. The rapid expansion of the automotive industry during the war with an unprecedented prosperity and purchasing power amongst the working and middle classes, taxed the capacity of the manufacturers to the limit, with the result that plants were unduly enlarged and many new companies created. With the slump, the conditions of the automobile industry have gone from bad to worse, the demand falling off in America to half the production capacity. The American market has reached a point of saturation and foreign markets must be developed if American plants are to be maintained at their present high state of efficiency and production. Approximately two and a quarter million cars can be turned out yearly by American factories, and of the present output only about eight per cent. are being exported. These conditions have brought home forcibly to the American automotive interests and their government which derives a huge revenue in taxes from these sources, the necessity of increasing exports in order to bring production more nearly to normal.

At the request of the national automobile chamber of commerce, the department of commerce has sent Mr. William L. Irvine a special expert to the Orient to investigate and report on conditions in Japan, China, Philippines, Siam, Indo-China, Malay States and India. American manufacturers consider that the Oriental market is capable of much greater expansion, and are prepared to do everything within their power to accelerate this development.

It may be said that the expansion of Far Eastern markets for automotive products, as in all other parts of the world, will go hand in hand with the construction of good roads, and whatever can be done to encourage and facilitate this desired end, should be carefully studied. In Japan, the government and its leading financiers are already working out a national system of new roads to connect the ports with the manufacturing centres, and the various provincial and municipal governments are appropriating huge sums each year for their construction.

In all countries of the Far East, with the sole exception of China, the various governments are appropriating increasing sums yearly for the construction of new roads, and a constant and steady development is the result. China alone, the greatest market of all, lags behind, with an empty treasury and no definite plan. There may be many ways whereby the automotive markets of China can be developed without outside financial assistance, but we are of the opinion that if any great expansion is to be realized, it can come only through some redical modification in the policy of the consortium powers which will enable foreign financial markets to come to the assistance of China.

The consortium policy is primarily a railway policy. It could not have been otherwise, as its fundamental function was to eliminate spheres of influence and harmonize the conflicting interests of the powers as expressed through their railway contracts, concessions and rights, which delimited these spheres. If the future railways of China are to be profitable, road construction must go hand in hand with their development, and provision made for advancing funds for that purpose. Or, as we pointed out in our special Automotive Number, issued in January last, a special financial institution should be created that could work with and through the more reputable Chinese banks in providing funds for road building.

A glance through the Automotive Notes in this section, will disclose that the Chinese are doing their best to construct new roads and create markets for mechanical transportation, but this is not enough to meet the demands of the foreign automotive industries compelled to seek export business to save their plants from deteriorating. A highway loan to China of say $100,000,000 would build 20,000 miles of new roads, and provide a market of for automotive products which would soon exceed the original investment.

At the present rate of road construction in the Federated Malay States, Siam and Indo-China, it will not be long before it will be possible to motor over metalled roads from the Chinese frontier town of Langson to the extremity of the Malay peninsula and Singapore. With Hongkong pushing its roads towards Canton, and the governments of Kwangtung and Kwangsi taking an active interest in highway development, not many years will elapse before it will be possible to motor from Hongkong to Singapore.

As a matter of fact, there are only a few sections from Langson south that remain to be completed. The road work in Fukien, Chekiang and Kiangsu provinces which is proceeding as rapidly as local funds can be advanced for construction, will bring the coast road to Shanghai. It sounds like a far off dream, but construction is going ahead and the dream may become a reality before two or three years are passed.

Is it worth while to assist in this development? If so, the automotive manufacturers not only of America but Europe should give serious attention to conditions in the Far East and exert influence upon their governments and financiers to find a way whereby financial assistance can be extended to China.

Trade Follows the Loan

ONCE in a blue moon, some hard-headed American business man comes to China and after listening to all the confidential rot poured into his ears about the monopolistic tendencies of the other powers which exclude Americans from the field, he forms his own conclusions from the facts. Such an observer was Mr. C. H. Chubbock, the vice-president of the McClintic-Marshall Company, one of the largest structural steel firms in the United States. In recounting his experiences to the Engineers' Club of Philadelphia, he gave his views upon the possibilities for American engineering business in China, and went on to give his opinion about the probabilities. He said: "But what are the probabilities? The probabilities are that on account of the American banker an engineer going out from here can spend months, can work his head off, and when he gets through he will come away the most disgusted man that ever 'came down the road.' An engineer of the Peking-Hankow Railroad told me, 'We like the Americans. We would rather do business with them than with anyone else on the face of the earth. But the European nations, French, British, Belgian, German and Italian, all of them will accept our loans and you demand an irrevocable letter of credit.' China is in exactly the same position as the United States west of the Mississippi River fifty years ago. If our American bankers then had taken the same attitude towards the development of our western states as they take toward the development of China, our great western areas to-day would still be a howling wilderness. *Gentlemen, trade follows the loan.* And as you travel around the world—I do not care whether it is China. Australia, the Malay States, New Zealand or wherever it is—an American representing large business interests has that constantly thrust into his face. On the Yellow River bridge, the only bid that did not figure on payment in government bonds was the American; and that I know, because mine was the only American bid.

"Now, how are you going to overcome that difficulty. Gentlemen, I advise you to go out there and look over the entire field. I am heartily in favor of Mr. Steinmitz's idea of having American engineers go over there and study the situation, but until our banking system becomes international in scope, you cannot do anything except become intensely interested and mad clear through to the backbone.

"You will find many opportunities. But the trouble is we send men who are not men of imagination—they are not men of vision. We send lawyers. Now, lawyers are fine in their place. But you know perfectly well that when you want to design a building, you have to see the picture before there is anything else done. You have to see that first and see it on a piece of paper. You will have to support the vision. A lawyer will tell you what is the matter with it after it is all over, but not before. So much for China."

Sharp, brief and to the point. Mr. Chubbock as an engineer probably left China "mad clear through to the backbone." We sympathize with him.

Commercial Aviation

A UNIFORM law governing the use of airplanes is essential if commercial aviation is to be developed on a business basis, in the opinion of the National Bank of Commerce in New York. Such a law must be at least national in scope and should be international, the bank believes.

"The development in the United States has been along lines different from that in Europe," the bank says in discussing the subject in the November issue of its magazine, *Commerce Monthly*, "due partly to the fact that the public has not been familiarized with flying as were the populations of the belligerent European countries and partly to the absence of a definite government policy. Commercial transportation companies have received neither assistance nor encouragement and in consequence private enterprises of this nature have accomplished very little. On the other hand the government, in the army, navy and post office departments, has been active in experiments of great value to commercial aviation so that in the United States the one distinctive example of successful aerial transportation on a large scale is not strictly commercial, but is merely civil, as distinct from military aviation.

"At the present time the air mail, including its contract lines, is the only manifestation of commercial activity in the air on any considerable scale in the United States. It is estimated that there are about one hundred transportation companies in the United States, but regular operation of substantial commercial importance has scarely begun.

"Commercial aviation is laboring under many difficulties. By far the greater part of the material in use is converted war material, built for extraordinary performance rather than economy. This material must in some way be worked off the market before new and better models can profitably be built. Traffic is light and variable and the uncertainty of its future volume and nature is a severe handicap. There are in addition many technical details, both in regard to material and organization, that appear to be of a minor character but frequently turn out to be important to economical operation. The greatest handicap by far to further development lies much deeper than present financial prospects of the industry. It is the continued lack of public confidence in the safety and reliability of air transportation.

"Since the armistice accidents have been increasing in number in some countries at a higher rate than the increase in flying. The most carefully compiled figures, those for British commercial aviation, show the death rate of passengers to have increased from 0.10 per thousand passengers carried in the six months ending March 31, 1920 to 0.22 in the six months ending September 30, 1920 and to 0.30 in the six months ending March 31, 1921. In the twenty-three months from May, 1919 to March, 1921, inclusive, twenty persons were killed and twenty-one injured in a total of forty-eight accidents or one accident for every 33,200 miles flown. In the United States the number of casualties, both in military and civil flying, has been alarming, although it is not possible to determine the accident rate as no official reports are required either of flights or accidents.

"The situation in the United States in this regard is very much worse than in most other countries, where government supervision of civilian flying is practised. The lack of official regulation of aviation, in some form, is the greatest detriment to increased safety in flying in the United States. The present situation in the United States is one of total absence of regulation, with the exception of a very few state laws and municipal ordinances. In most parts of the country there is nothing to prevent any pilot from operating any machine, without regard to his competency or its condition. It may well happen and often does happen that an irresponsible pilot will fly a machine unfit for use, with imminent danger to the life of himself, his passengers, and the safety of the community. In case of accident the entire aircraft industry suffers through the injury to its most vital asset, its reputation with the public.

"The operation of airplanes for other than transportation purposes would, if properly regulated and supervised, perform a valuable service to commercial aviation by familiarizing large numbers of people with the advantages of aerial transportation. A system of licensing by which the safety of such flying could be improved cannot be established, however, without the enactment of an air law. That an air law must be at least national in scope is evident from the very nature of aviation and considering the distances already covered by commercial air routes the advantage of a law which is internationally uniform is apparent.

"Efforts to establish an American air law have encountered a fierce conflict in regard to the form of the supervising organization and as yet have been without tangible results. It is gradually being realized by all those concerned with the future of American commercial aviation that the need for an air law is so pressing that its method of administration is a secondary consideration. When this attitude becomes general substantial progress may be expected. Wise regulation may be expected to give a certain stability to the air transportation industry essential to any industry which must appeal for credit and for investment capital. Until this is attained air transportation cannot be said to be on a business basis."

Artificial Silk

ARTIFICIAL silk may offer severe competition to the natural product of the lower grades as a result of present conditions in the silk market. The National Bank of Commerce in New York declares in its magazine, *Commerce Monthly*, that the greatly increased capacity of domestic producing plants indicates that American manufacturers of artificial silk goods may in the future be practically independent of foreign supplies.

"The position of the United States in international trade in artificial silk has been radically changed since the beginning of the war," the bank says. "For some ten years before domestic production began in 1911 the United States imported artificial silk threads and yarn, although the quantities are impossible to trace before that year. From 1911 until 1915 both production and importation increased, the former more rapidly, so that in 1915 about 60 per cent. of the total consumed in the United States was produced at home. The submarine warfare and the intense need of all textile materials in Europe, coupled with a reduced production in most European countries, caused a sharp decrease in imports at the same time that production in the United States was rapidly expanding. In consequence 98 per cent. of the 1918 consumption was of domestic manufacture. Soon after the close of the war European production was resumed and expansion begun and American imports in 1920 and 1921 approached in volume and greatly exceeded in value the high figures of 1914 and 1915 despite a greatly increased domestic production. In 1920 domestic yarns comprised about 80 per cent. of the total consumption.

"The first producing plant in the United States was established in 1911 as a branch of an English firm and used the viscose method. For many years this was the only important produce in the United States. From the 1911 figure of 320,000 pounds the production of this concern mounted to 9,000,000 pounds in 1920 and at the present time expansion is under way which will more than double its capacity. The increased demand for artificial silk in 1920 led several other large concerns to enter the field. The most important of these are affiliated with prominent manufacturers in Belgium, France and Italy.

"Although the potential production of plants now operating or under construction is far above any consumption figure yet attained, manufacturers believe that the market for artificial silk has as yet been only partially developed. It is significant that except for the latter part of 1920, when all textile industries suffered a depression, the demand for artificial silk from the beginning of the war so far exceeded the supply that the output of American plants was allotted to important consumers and until recently has rarely been sold in a freely competitive market. American producers have made little effort to expand their market as it was impossible during the war to increase production to supply new customers.

"Of the total consumption in the United States the largest share used in any one industry is in the manufacture of hosiery. In the last few years the production of sweaters and other knitted goods has been important. Artificial silk is woven with natural silk, cotton or other fibre into dress goods, such as satins and fancy silks, and shirtings and tapestry. Plushes, carpets and imitation furs are now made of artificial silk and many kinds of fringes, tassels and novelties.

"The manufacturer of artificial silk has also the opportunity of developing other products with the same equipment and raw material. By increasing the size of the aperture through which the cellulose solution is forced artificial hair may be produced, of value in the manufacture of hats, upholstery materials and fancy goods. By changing the shape of the apertureto a horizontal slit, he may make artificial straw, or by further widening the slit strips of artificial leather or cloth, films, ribbons or thin transparent sheets such as are used in facing envelopes and wrapping candies.

"A method has been devised in which net and simple forms of lace are produced in one operation, by passing the solution into engraved lines on a revolving cylinder, from which the finished product is continuously peeled as it issues from the fixing bath. Further progress in this direction may be confidently expected as the possibilities of cellulose are as yet far from exhausted.

"Artificial silk is chemically unlike natural silk and differs in most of its physical properties so that there has not been direct competition between the two fibres. In the period of activity in textile markets which followed the close of the war the demand for both these fibres exceeded the supply. Such substitution of artificial silk as was possible served only to release natural silk for other purposes. The present condition of the silk market, however, offers the possibility of severe competition between artificial silk and the lower grades of natural silk as the supply of the latter is in excess of immediate needs.

"In view of the greatly increased capacity of American producing plants, and of the apparent policy of foreign producers to affiliate with producers in the United States rather than to obtain a market in the United States for foreign products, it is probable that American manufacturers of artificial silk goods will in the future be practically independent of foreign supplies, and it is even possible that yarn may be exported in important quantities. The variety of sizes and kinds of artificial silk which can now be produced in the United States leaves little to be feared from foreign competition, and the export trade in hosiery and other manufactures has a promising future."

Fushun-Mukden Power Service

The electric power transmission system from Fushun Collieries to Fengtien (Mukden), in course of construction since last year, under Sino-Japanese joint management at the cost of Y.560,000, has been completed, and the actual transmission of power may be opened by the middle of February.

This project was conceived five years ago, but actual work has been deferred owing to the difficulty of securing the consent of the Chinese. Mukden had been feeling the inadequacy of power supply. Such plants as the Manchuria-Mongolia Woollen Manufacturing Co., the Manchuria-Mongolia Fibre Industry Co., and other plants have been suffering from the short supply of motor power. Against the 1,400 kilowatt capacity of the present power station, the monthly demand runs up to over 300,000 kilowatts. When the new arrangement comes into operation, 3,000 kilowatts will be supplied from Fushun, which will prove sufficient for the few years to come. The capacity of the new installation may be raised, with a little alteration, easily to 6,000 kilowatts.

MANCHURIA and MONGOLIA

The Lands of Opportunity

Sheep Grazing at the S. M. R. Agricultural Station at Kungchuling

I. Geography

GEOGRAPHICAL SCOPE.—There is no definite boundary to what is generally called "Manchuria and Mongolia." What are often referred to as Japan's special privileges in Manchuria and Mongolia are embodied in various treaties, protocols, etc., and allude to rights in South Manchuria and the Eastern Inner Mongolia.

ADMINISTRATIVE DISTRICTS.—Manchuria consists of the three provinces of Fengtien, Kirin and Heilungkiang, subdivided into the following minor districts :—

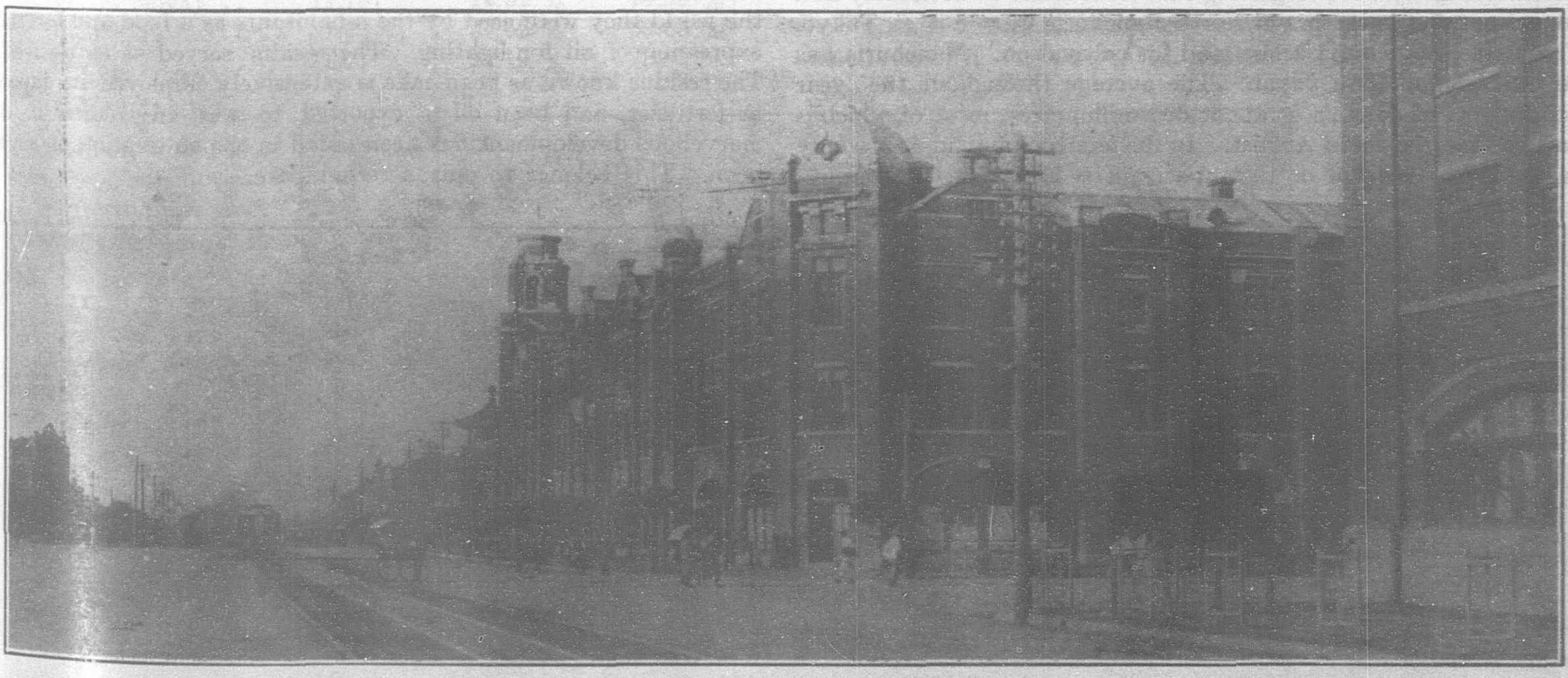
Fengtien into 5 *tao* (district superintendencies) and 57 prefectures ;
Kirin into 4 *tao* (district superintendencies) and 39 prefectures ;
Heilungkiang into 3 *tao* (district superintendencies) and 31 prefectures.

Each province has a *tuchun* (military commander) to supervise military affairs and a civil governor under whom are the *taoyin* (district superintendents) and prefects. The real political power is, however, held by the military commander.

Eastern Mongolia is divided into the four tribes of Chelimu, Chasakotu, Chaowuta and Hsilinkuoerh, subdivided into thirty clans, each having its own chieftain. The Mongolians being nomads, the waste lands in their country are being colonized by Chinese.

TOPOGRAPHY.—The eastern part of Manchuria is mountainous, and borders on the Russian littoral provinces and Chosen by the Ussuri, the Tumen, the Changpai range, and the Yalu. On the west, the vast level plain of Mongolia stretches afar to the horizon, part thereof being walled by the Hingan range. On the north, it adjoins the Russian Amur province across the Amur, whilst on the south the Yellow Sea and the Gulf of Pechili wash its shores. For some distance, it borders on China proper following the Great Wall. The Mongolian plain is undulating and contains deserts and alkaline belts. The rivers are the Liao, the Sungari with their tributaries, the famous Yalu and Tumen, the Muling, etc. The valleys of these rivers are fertile, highly suited to cultivation. Even in the hilly regions, there is little space admitting of reclamation.

AREAS AND POPULATION.—There are no accurate statistics about either land areas or population.



The New City of Mukden with wide avenues and beautiful buildings created in the Japanese railway zone. The Chinese city in all its squalor and dirt lies three miles distant, connected with the S. M. R. Railway Station by a horse tramway

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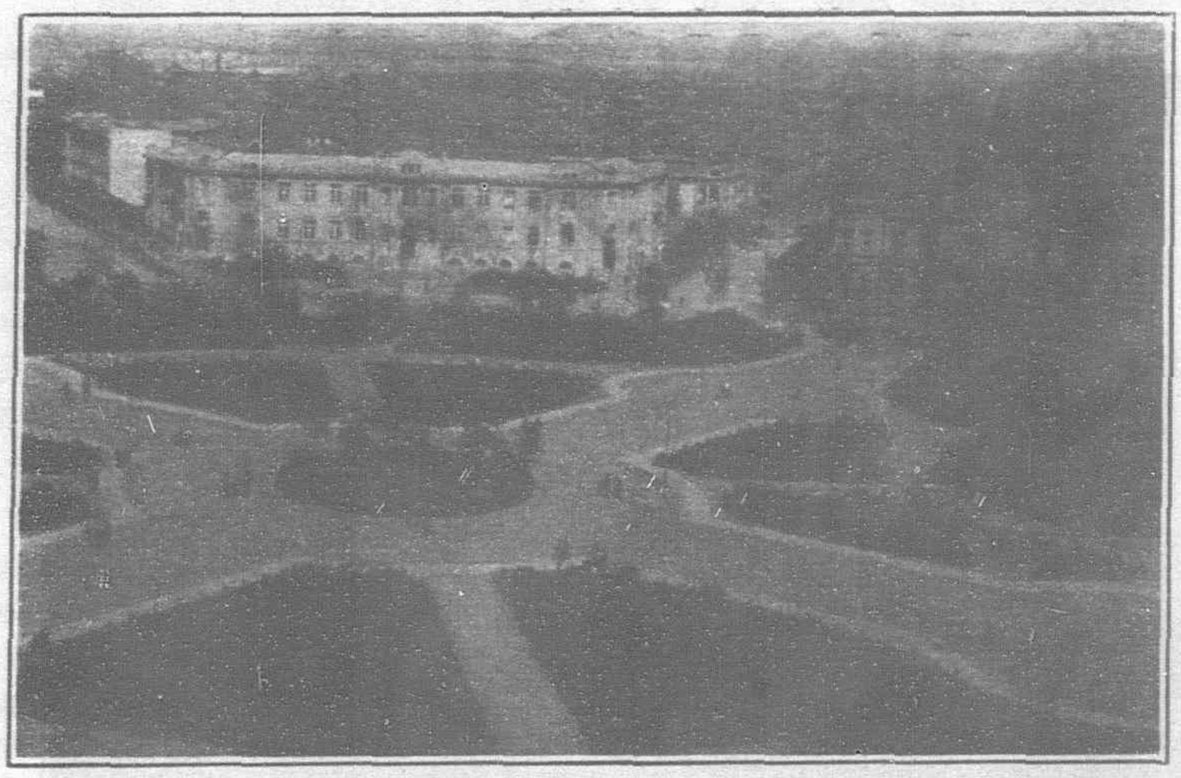
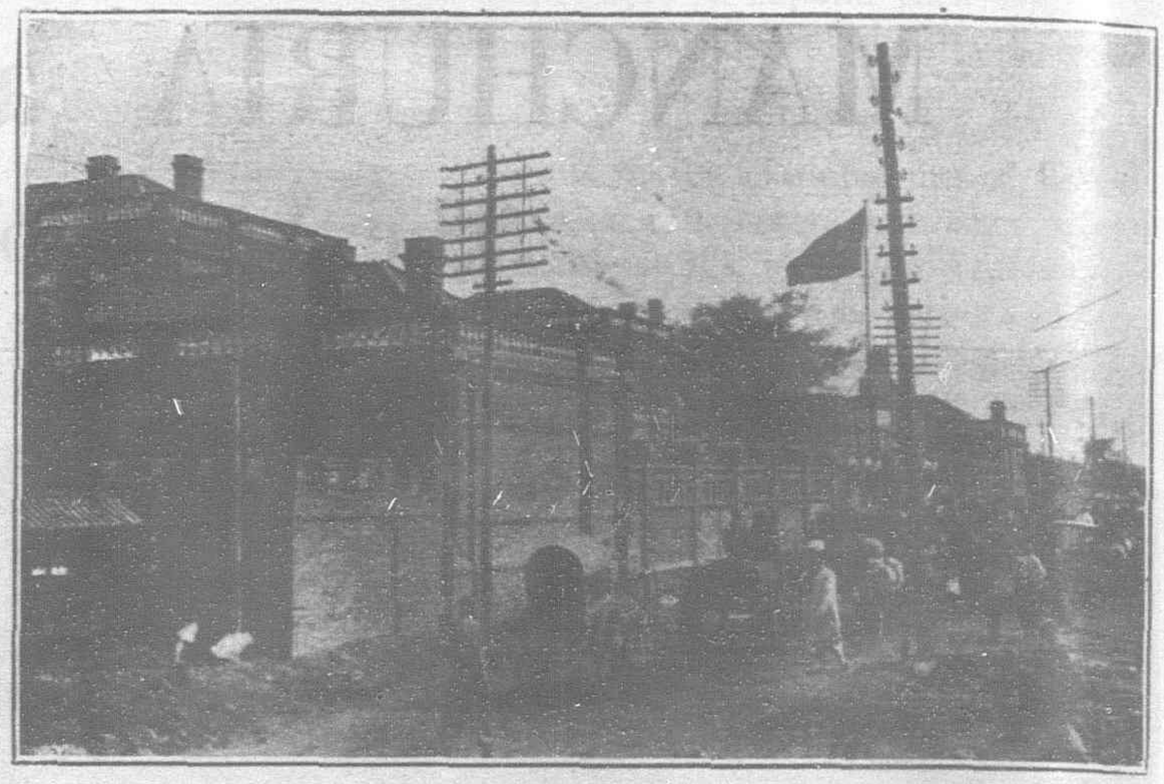


The Magnificent Civic Centre at Dairen



The Yamen of Marshal Chang Tso-lin, at Mukden

According to a recent estimate of the South Manchuria Railway Company, the areas and population of Manchuria and the Eastern Inner Mongolia are as follows :

	Area square *ri*	Population
Fengtien province..	15,151	11,979,400
Kirin province	13,605	5,638,700
Heilungkiang province	35,497	2,494,000
Eastern Inner Mongolia	10,168	4,366,000
Total	74,421	24,478,100

Remarks: 1 square *ri* is approximately 6½ square miles.

The above shows that Manchuria and Eastern Inner Mongolia are far larger in area than Japan, but with only one-third the latter's population. The average density of population is 330 per square *ri*. In Fengtien province, the land under cultivation reaches 60 per cent. of the arable area and has the highest density of population. Manchuria is inhabited by Manchus and Chinese, and Mongolia by Mongolians and Chinese settlers. There are also about 600,000 Koreans, 1,200 Russians and 200,000 Japanese. Chinese farmers are taking up land in large numbers, and with the natural increase of population, the annual rate of increase is placed at between 400,000 and 500,000.

CLIMATE.—The climate of Manchuria and the Eastern Inner Mongolia is what is called "continental" with extremes of heat and cold. People labor under the impression that Manchuria is frigidly cold, forgetting that its summer is intolerably hot. In summer, both South and North Manchuria is as hot as Tokyo. This makes Manchuria a fine land for cultivation. Manchuria has far less rainfall than Japan. The average throughout the year is one-third of Japan's or about 600 millimetres, most of which is bad in June, July and August. In the Mongolian plain, it is windy in spring. No storm or torrential rain is known in autumn.

II. Agriculture

RAILWAY AND DEVELOPMENT OF AGRICULTURE.—The vast plain of Manchuria and Eastern Inner Mongolia is covered with layers of loam, clay and humus, making one of the most fertile agricultural countries in the world. The Chinese Eastern Railway, the South Manchuria Railway, and the Peking-Mukden line of the Chinese Government Railways carry annually large numbers of immigrants and immense stocks of produce, facilitating the development of agriculture

According to investigations of the S. M. R. Co., the total area under cultivation is about 39,100,000,000 *tsubo*, of which 32,510,400,000 *tsubo* is in Manchuria and 7,692,000,000,000 *tsubo* in Eastern Inner Mongolia. The farming lands awaiting cultivation is put at about 30,000,000,000 *tsubo*, of which 80 per cent. lies in Heilungkiang province. The annual increase of area under cultivation ranges from 900,000,000 to 1,200,000,000 *tsubo*.

(*a*) BEANS.

Beans may be classified into yellow (soya) bean, blue and black beans. In fact, there are more than two hundred species of beans. The yellow (soya) beans belong to the most common species, containing a good percentage of oil and are used as an article of food and for the expression of oil. Now widely known all over the world they were used by the inhabitants as a food and for the expression of oil for lighting. The residue served as cattle feed. The residue known as bean cake is extensively employed in Japan as fertilizer, and bean oil is exported to western countries. A marvellous development has been noted in the cultivation of soya bean. This belongs to only a recent date.

Electric Tramcars and Goods Sheds at the Dairen Wharves

Bean milling industry, too, has correspondingly grown up, and along the South Manchuria Railway lines, and especially at Dairen, there are a large number of bean mills on a considerable scale. The beans, bean cake and bean oil exported from the port of Dairen have reached 3,000,000 tons annually in recent years.

The Chinese not only use beans and bean oil in their daily cooking, but also *tofu* (bean curd palatable also to the western palate and pronounced by the qualified chemist as similar in its composition to cow's milk), *miso* (an article of the staple food to both Japanese and Chinese), and *soy* are also made from beans. Bean oil exported to the west is understood to be refined as substitute for cottonseed oil, peanut oil, linseed oil, etc., and even for animal fat. It can be made into soap, oleomargarine and paint. New utilities are being invented for beans and bean oil.

Beans put out in Manchuria and Mongolia are put at about 20,000,000 *koku* (1 *koku being equivalent to* 4.96 *bushels*), but the outputs are increasing rapidly year by year, and there is a vast area of territory awaiting cultivation.

The analyses of bean oil at different spots in Manchuria are as under, the average of ten samples being given :—

At	Oil	Water
Harbin	17.77 %	11.90 %
Changchun	18.16 %	10.27 %
Kaiyuan	18.14 %	10.76 %

Next, the results of analyses of beans of different kinds are as follow, the average of several samples being given :—

Beans	Crude oil	Albumen	Carbohydrate
Yellow (soya) ..	11.78 %	16.92 %	14.99 %
Blue	37.32 %	37.62 %	38.65 %
Black	21.77 %	22.19 %	26.06 %

(*b*) KAOLIANG.

Kaoliang is ubiquitous in Manchuria. It is grown most extensively and is the chief of the staple food of the natives. For this reason, in North Manchuria, in which *kaoliang* is produced in less quantity than in South Manchuria (while the cultivation of wheat is incomparably larger), a restriction is put by common consent upon the amount of *samshoo* (a kind of alcoholic drink) distilled from the same cereal.

Kaoliang is first husked and cleaned before being cooked in the form of gruel or being boiled and then sun-dried. It is also used as fodder.

Recently, a Japanese resident at Dairen has hit upon a process by which a fair imitation of rice can be made from *kaoliang* in shape and taste.

As previously hinted, *samshoo* is distilled there from in large quantities.

The *kaoliang* stalk is used as fuel and a building material, and further matting is made therefrom. Its uses are varied as well as extensive.

The annual outputs of *kaoliang* are estimated at 36,000,000 *koku*.

(*c*) ITALIAN MILLET.

Italian millet, when cleaned, is called *hsiaomi* (small rice) by the Chinese. Its importance ranks only next to *kaoliang*. An intoxicant known as *huangchu* (yellow drink) is brewed therefrom. It has divers species, and the tallest grows as high as from 6 to 7 feet.

The millet straw supplies the chief fodder for the domestic cattle, whilst the millet bran serves as hog feed. On this account, the millet, too, is raised everywhere, its yearly production being placed at 30,000,000 *koku*.

(*d*) MAIZE.

Maize may be subdivided into three kinds—yellow, red and a native breed called *laolaichou*. It is grown in the south of South Manchuria and also in part of North Manchuria and also forms an important article of food. In North Manchuria, an intoxicant is brewed from it. The stalks are used as an article of fuel whilst the leaves are good for fodder. The annual outputs are about 10,000,000 *koku*.

(*e*) RICE.

Rice is known as *tami* (large rice in distinction from *hsiaomi*, small rice or millet) among the Chinese. It is a valuable article of food too to the Chinese peasantry. Upland rice, which is grown on dry farms, is produced to the extent of about 3,000,000 *koku*, and ordinary rice raised on paddy fields to the extent of about 500,000 *koku*, in both cases unhulled. It may be mentioned that the growing of ordinary rice has been undertaken in Manchuria only in recent years, and is therefore still produced to an inconsiderable amount. However, both soil and climate are well suited to its cultivation. The Korean settlers in Manchuria

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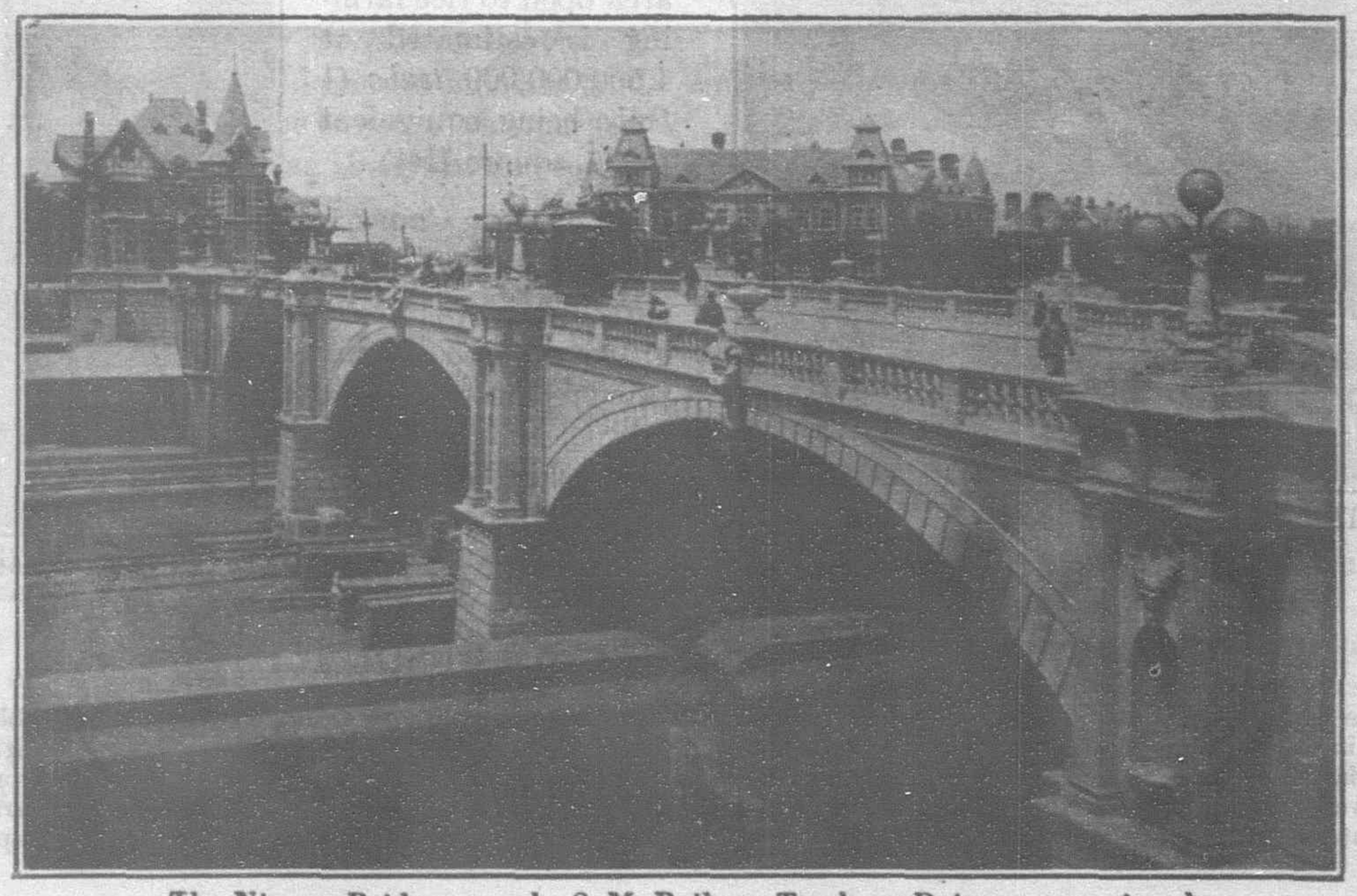
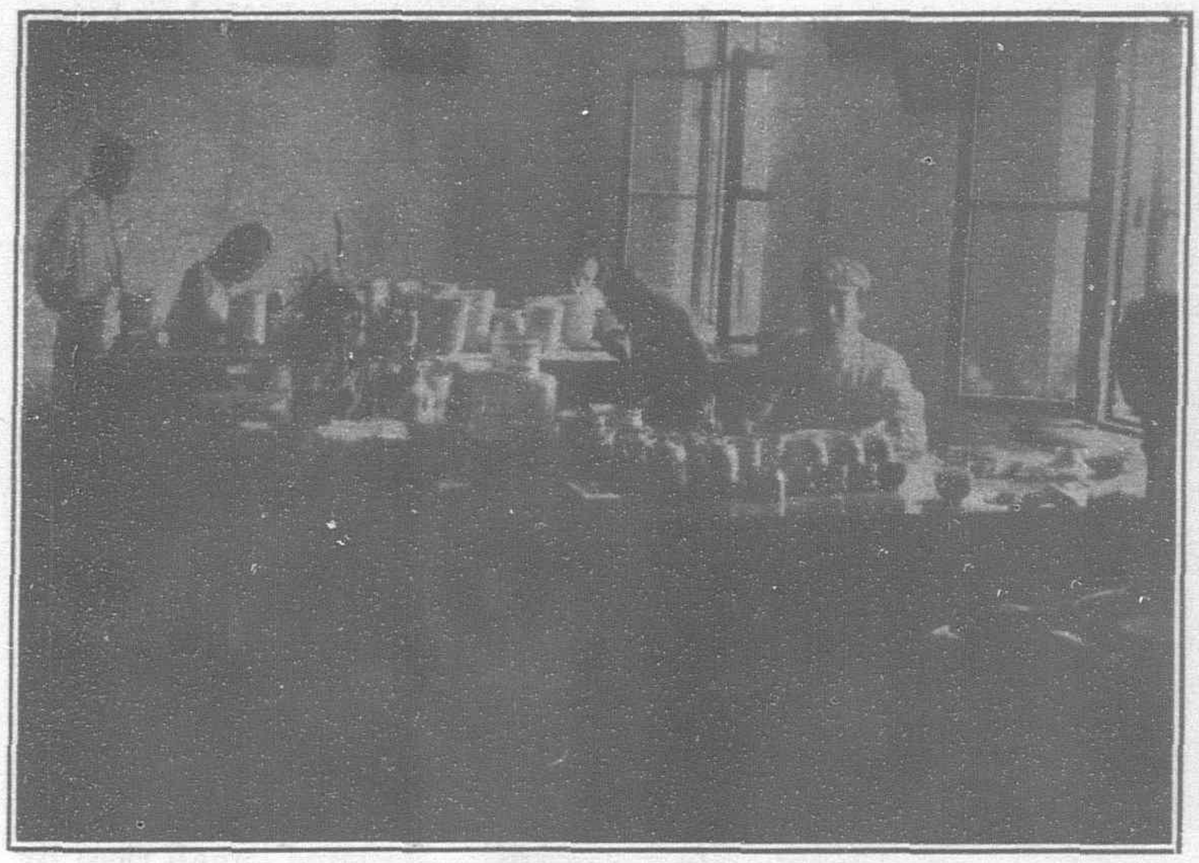
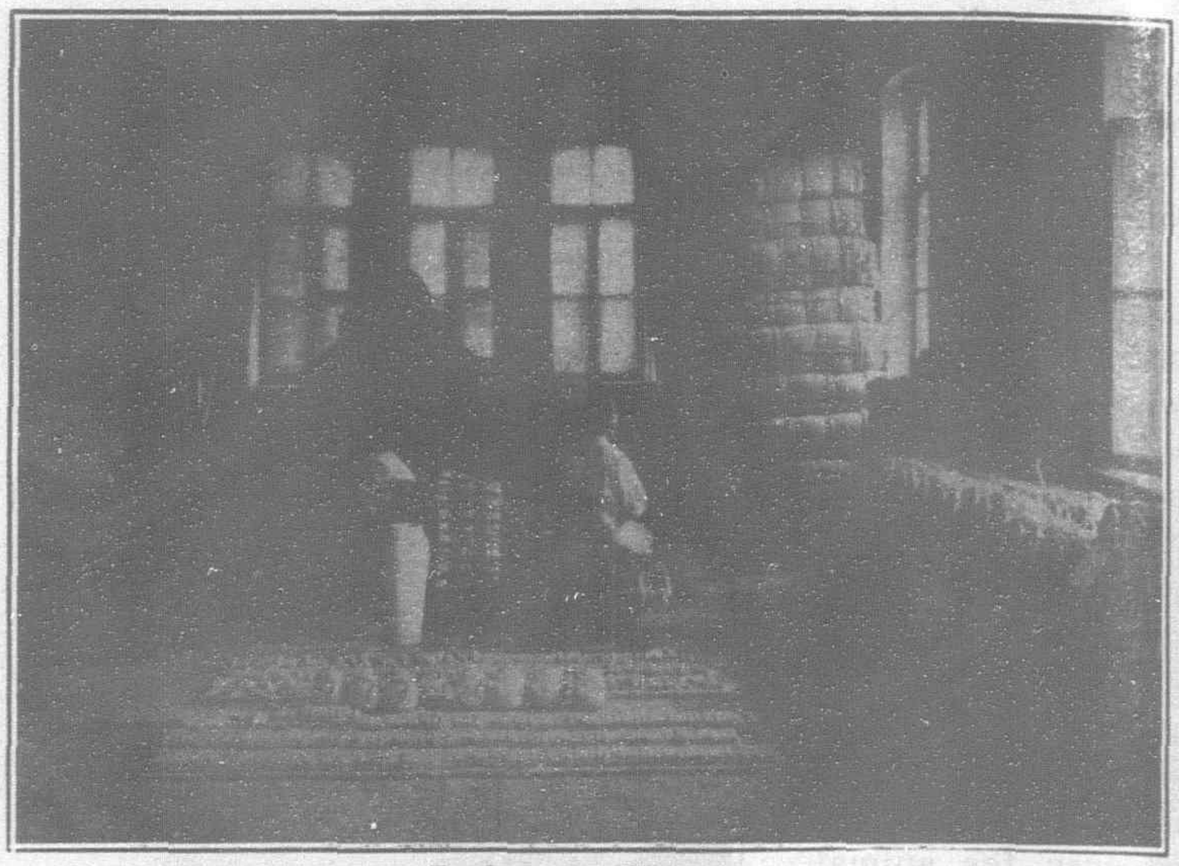
The Main Street of the Chinese City of Changchun, the terminus of the S. M. Railway



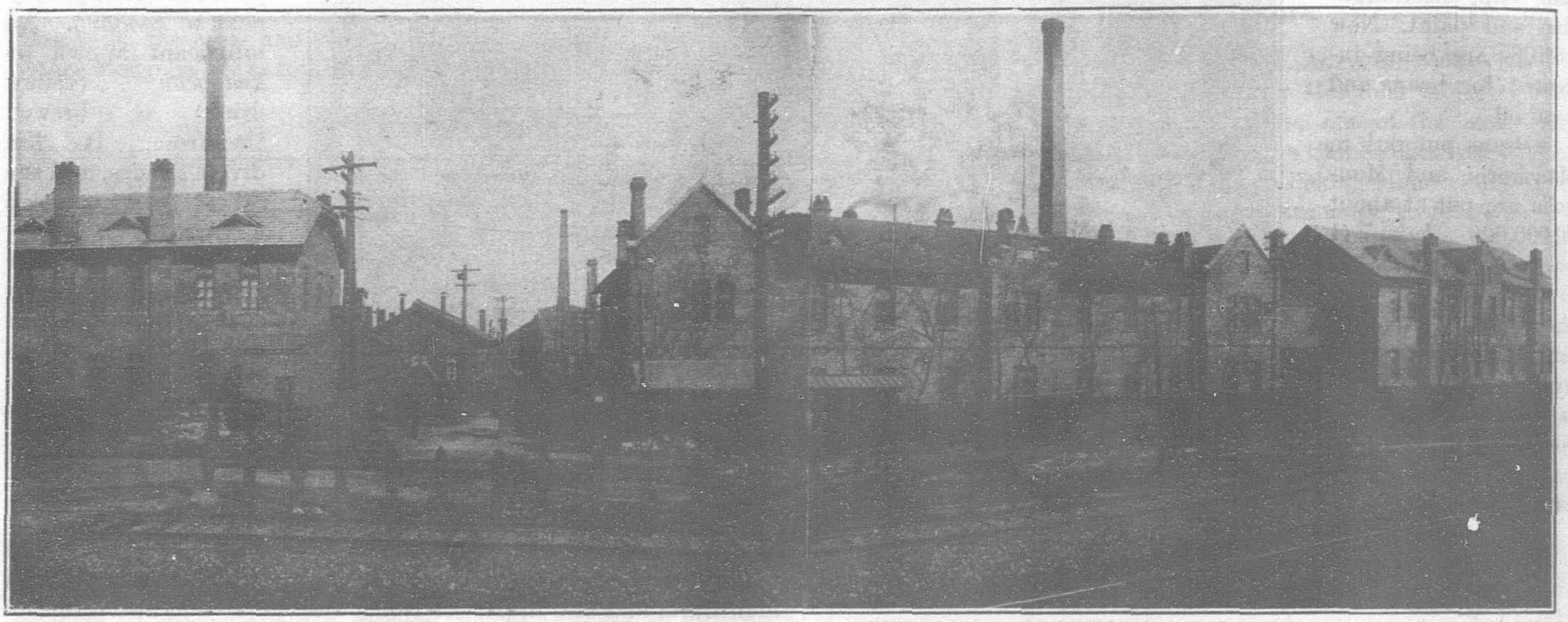
The Nippon Bridge over the S. M. Railway Tracks at Dairen connecting the old Russian Town with the Modern City



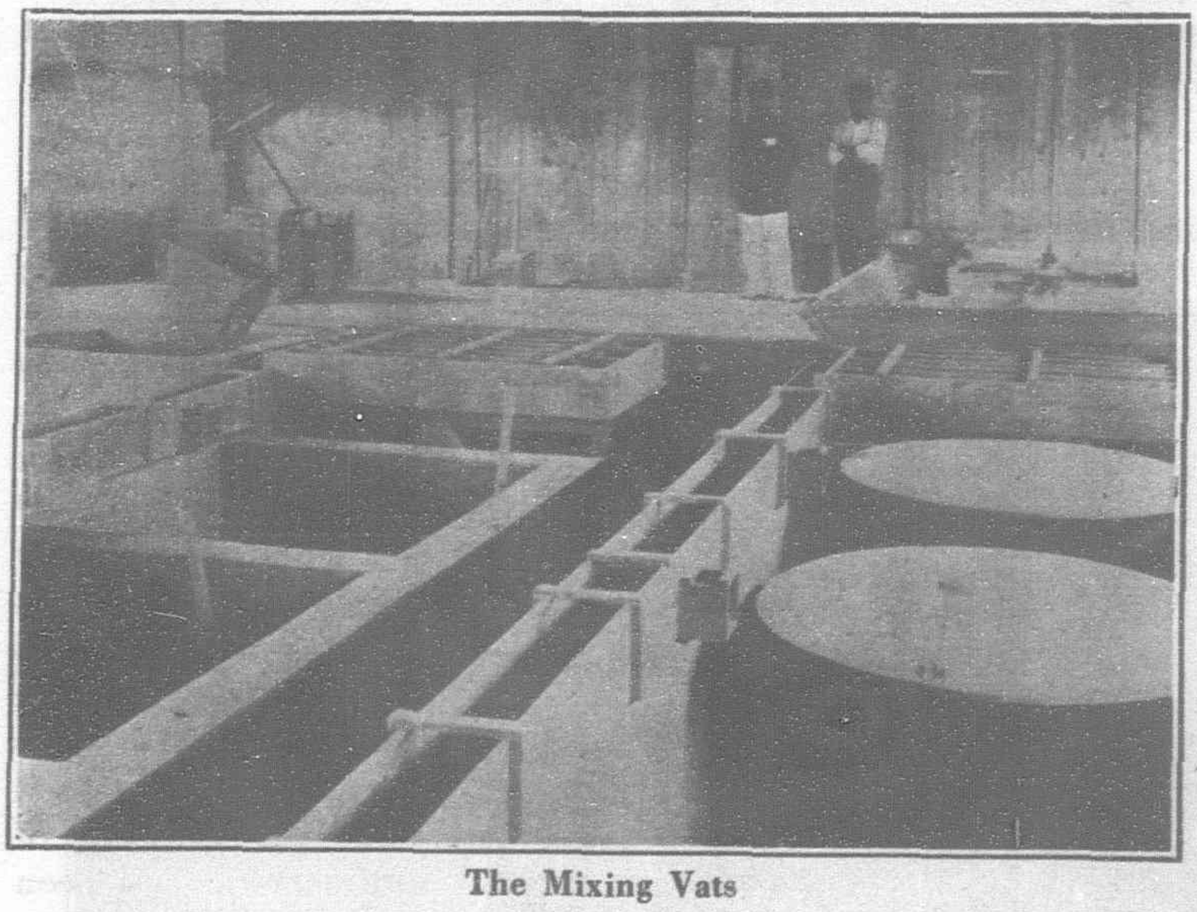
Decorating Bowls



Packing for Shipment



The Ceramic Works at Dairen erected by the S. M. R. and turned over to the Tahua Pottery Company

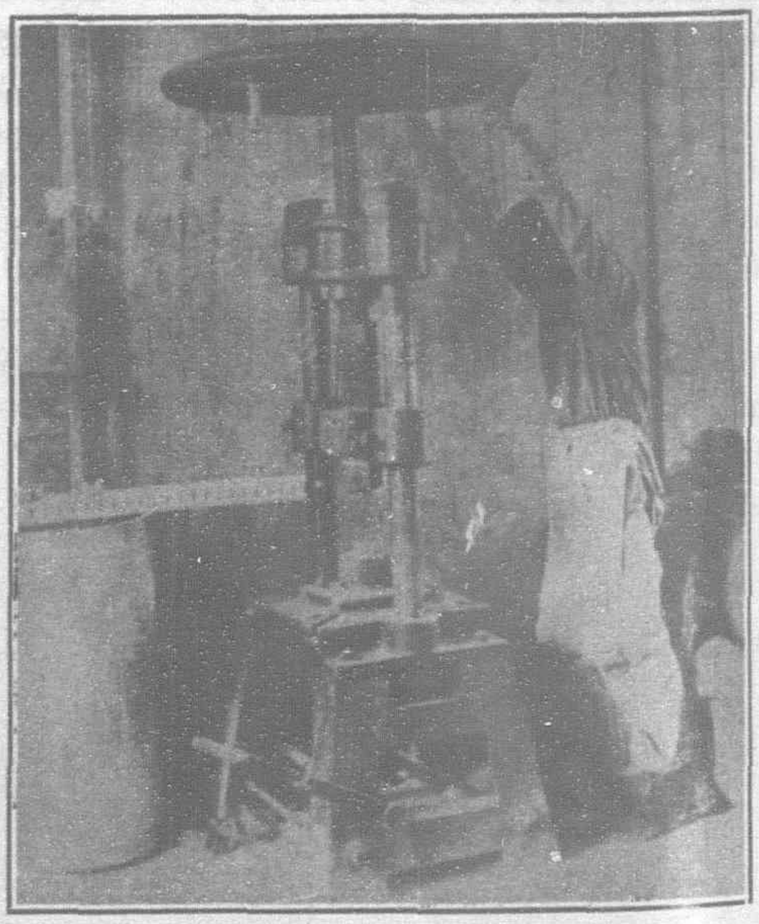


The Mixing Vats

nearly monopolize the cultivation of this cereal. The amount of cultivation is expanding yearly at a rapid pace. The land area open to rice farming is estimated at 4,500,000,000 *tsubo* (1 *tsubo* being equivalent to 36 square feet).

(*f*) Other Crops.

Among other agricultural crops popularly grown may be enumerated red beans, kidney beans, millet, wheat, cock's shin, buckwheat, oats, potatoes, etc.



Moulding Press

DEVELOPING MANCHURIAN RESOURCES

Under Chinese rule, the manufacture of pottery in Manchuria was confined to coarse earthen ware. The cheapest table ware was imported from other parts of China. The central laboratory of the South Manchuria Railway at Dairen investigated the possibilities for manufacturing fine white china and glassware from native raw materials and the result was the establishment of the large ceramic works at Dairen, whose management in 1920 was handed over to the Tahua Pottery Company. At present the works turn out a superior grade of table crockery, insulators, and especially bowls for Chinese consumption. The products are being exported even to Japan.

Next, as regards crops for special uses, hemp, flax, tobacco, sesamum, perilla, melon-seed, etc., are grown.

The hemp and flax crops are placed at some 40,000,000 *kin* a year. The tobacco is produced in Kirin province to the annual amount of about 50,000,000 *kin*. Still, the supply being inadequate, about Y. 6,000,000—7,000,000 worth is being imported yearly.

Next, turning to agricultural crops introduced lately, the sugar beet has been found to thrive excellently. The flax is looked upon in a similar light.

In the belt from the Kwantung leased territory up north to Mukden, the orchard industry is pronounced as promising. For instance, superior species of apples, pears, grapes, etc., are produced recently in increasing quantities.

METHOD OF CULTIVATION.—Agriculture in Manchuria may appear crude to a casual eye, but when one looks deeper into its methods, one will easily find that what are in vogue are sensible devices adapted to climate and soil and developed through stages. In harrowing and ploughing, oxen, horses and mules are employed to draw the ploughs and harrows, and rollers are brought to play in levelling work after the western fashion. Domestic cattle are utilized to economize human labor, and in these respects, the Manchurian methods differ from the Japanese ways.

In fertilizing lines, droppings of the domestic animals and night soil are mixed with rich soil and are left in heaps, exposed to the weather for about three years. Chemical fertilizers still remain strangers to the native peasantry.

In dealing with the cereals, after they have been harvested, the grain is unhusked with the help of the domestic animals, and then it is packed in gunny or cotton bags to be carted to the market. The domestic animals are used also in cleaning the grain and in the home milling of flour.

Insects' ravages are considerable in some years, but the peasantry, whose heads are crammed with old superstitions, hold them as little short of a visitation and do not trouble themselves with their extermination or prevention. Luckily, the happy climatic effects Manchuria act fatally upon these insects, and it is through this natural boon that their harm is not more serious.

MANAGEMENT.—Farming is carried on by the land-owners and the tenants. The tenancy system may be divided into three kinds, ordinary, profit sharing and contract plans. In extensive farming, in some cases, over 300,000 *tsubo* of land is looked after by a single family. Those attending from 60,000 *tsubo* to 150,000 *tsubo* of land each are rated as farmers of intermediate class. The petty peasants have only 15,000-60,000 *tsubo* to till, and in many cases, not more than 4,000 or 6,000 *tsubo*.

In Manchuria there is an element that is termed as farming hands who are helpers immigrating into Manchuria from Shantung, etc., which are more densely populated.

AGRICULTURAL INSTALLATIONS.—In lines of agricultural installations, the Chinese authorities maintain agricultural experimental stations at Fengtien (Mukden), Kirin and Tsitsihar.

The South Manchuria Railway Company, having recognized early the urgent necessity to improve and advance the argicultural methods in the development of Manchuria and Mongolia, has founded an experimental station at Kungchuling and Hsiungyocheng each at enormous outlay, and has been carrying on the investigation and experiments of agricultural methods, stock farming and afforestation.

An experimental station for the cultivation of the tobacco has been opened at Telissu between Wafangtien and Hsiungyocheng.

In addition, minor experimental stations are maintained at Chengchiatun on the Ssupingkai-Taonan line of the chinese government railways.

At the Kungchuling station, such corps comparatively new in South Manchuria as sugar beets, tobacco, flax, etc., are being experimentally raised, while the improvement of the bean breed has been receiving special attention. The stock-farming division has conceived the idea of improving the sheep breed, and incidentally the hog breed.

Making Vermicelli at Wangchiatun near Dairen, for Chinese consumption

At the Hsiungyocheng station, sericultural industry, fruit raising, horticulture, and afforestation have been studied.

These investigations and experiments are expected to bring in important results to the agricultural Manchuria.

III. Stock-Farming

STOCK-FARMING COUNTRY.—The Japanese farmers are short zsen of cattle for use in the field. Therefore, Japanese agriculture is often referred to as "agriculture without animal help." In striking contrast with this state of things, in Manchuria, stock farming is indeed almost universal among the farming classes, and few farming houses are met with that do not keep at least three or four heads of cattle, horses, mules, etc., and some pigs and poultry, into the bargain.

It may be said that the Chinese are not always more attached to stock-farming than the Japanese, but they beat the Japanese hollow in the knack of domesticating and training the domestic cattle. Five or six head of cattle, horses, mules or donkeys are hitched up at random to a heavily-loaded cart, and this motley team is managed with admirable dexterity by a Chinese driver with the cracks of whip in hand.

As to the Mongolians, they are nomads, and the live stock serves as the only means of sustenance to them. In other words, they keep live stock consisting of cattle, horses, sheep, etc., and lead a nomadic life from place to place.

We shall now give a resume of the stock farming in Manchuria.

(*a*) Horses.

Manchuria and Mongolia are what has been referred to from old times in China as the finest horse breeding centre. The horse all belong to the Mongolian breeds. They stand 4½-ft. and 4.75-ft. long, weighing 583-lb. on an average. They are rather undersized but well proportioned. They are built very strong and are used to coarse feed, neglect and even exposure; moreover they have endurance to a wonderful degree. In ordinary circumstances, those that can pace are used for riding purposes, and the others as draught animals.

According to the latest returns prepared by the South Manchuria Railway Company, the horses in Manchuria and Inner Mongolia number about 2,500,000 head, comprising 750,000 head in Fengtien province, 500,000 head in Kirin province, 510,000 head in Heilungkiang province and 810,000 head in the Eastern Inner Mongolia.

(*d*) Cattle.

The cattle in South Manchuria, etc., belong to the Korean, Shantung, Manchurian and Mongolian breeds. The first mentioned two breeds are comparatively small in number, the last mentioned two constituting the majority.

The Chinese keep cattle to work them, and the Mongolians for the milk they yield, the beef being regarded as by-product.

The cattle in South Manchuria and Inner Mongolia are defectively developed in hinderpart and are rather inferior in all economic efficiency. But these drawbacks are made up by their power of endurance and docility, and that of withstanding neglect and exposure, which qualifications all go to befit them for hard labor. In weight, the heaviest is 1,166-lb., those weighing 666-lbs. being most common. Accordingly, they give a comparatively meagre amount of beef. In quality, the native breed is classed below the Korean and Shantung breeds, and gives only a stinted amount of milk. There is ample room for future improvement with the cattle as with the horse.

The cattle in Fengtien, Kirin, Heilungkiang, and the Eastern Inner Mongolia are put at 580,000 head, 90,000 head, 210,000 head and 1,120,000 head respectively, making the grand total of over 2,000,000 head.

Sulphate of Ammonia Factory at Anzan, South Manchuria

(*b*) Mules.

The mule is the cross breed between the she-donkey and the he-horse. It has existed in Europe and China from early times, but has been unknown in Japan. In size, the mule varies according to the sizes of its parent-animals, but is, in many cases, larger than the horse. This is because the he-donkey used for breeding purposes is what is known as the larger donkey standing from 4-ft. 7-in. to over 5-ft.

The mule is employed in both farming and transport. It has great endurance and is inured to hard labor of a long duration, ill-fed and ill-sheltered. It costs dearer than the horse.

There are 200,000 head thereof in Fengtien province, 230,000 head in Kirin province, 120,000 head in Heilungkiang province, and 70,000 head in the Eastern Inner Mongolia, totalling 630,000 head.

(*c*) Donkeys.

What belongs to the class of smaller donkeys is commonly kept in the native households. One stands only about 3-ft. It is strong of body and thrives on coarse feed. Its bearing strength is great for its size, and this makes it suited to agricultural, domestic, and transport uses. Some 500,000 head thereof are in South Manchuria and about 100,000 head more in the Eastern Inner Mongolia.

In the Eastern Inner Mongolia, cowhides are put out in a considerable quantity, but owing to their poor quality and also the parasitic worm that eats out many holes in important parts, they have but an insignificant value.

(*e*) Camel.

The camel is found only in Mongolia. It is double-humped and stands 5½-ft. usually. It withstands the cold and is adapted to hard labor and is good to ride on. For this reason, it is an important medium of travel in Mongolia. Its number is put at about 4,000.

(*f*) Sheep and Goats.

The sheep and goats are of Mogolian breeds. Hitherto they have been raised chiefly for their meat and skins, and the wool have been regarded as but a by-product.

The ewe weighs from 58-lb. to 83-lb.; the ram weighs about 125-lb. at the outside. One of its characteristics lies in storing nutrition in the fat rump.

Goats are a little smaller in size than sheep. They yield only a small quantity of wool.

The sheep gives not more than 3-lb. of wool each of a quality far from passable. Most of it has been exported to the United States.

On the other hand, the goats' hair is of finer quality, but is a matter of only a little more than 1-lb. per head.

With the recent development of woollen industry in Japan, both wool and goats' hair have begun to be exported to Japan in a considerable quantity.

In South Manchuria, goat-raising takes precedence of sheep farming among the Chinese. In Mongolia, the natives attach the highest importance to sheep-raising. In both cases, more or less mixed farming is in vogue. To the Chinese, sheep- and goat-raising is only a secondary occupation, but to the Mongolians, live stock forms the principal property asset and the chief item of sustenance.

Judging by the outputs of wool and goats' hair, both sheep and goats combined are put at 400,000 head, 100,000 head, 60,000 head and 2,000,000 head in Fengtien, Kirin and Heilungkiang provinces and the Eastern Inner Mongolia respectively, making the total of 2,660,000 head.

Seen from the traditional aims of sheep- and goat-farming more for the sake of the meat than for the wool, no improvement seems necessary, but since the greater utility of wool than the meat itself became more widely known, the benefit of a systematic improvement on scientific lines has come to be noted more keenly.

(*g*) Pigs.

Pork is accepted by common consent by the Chinese as the most palatable. Hogs are kept at every farm house from a few to a dozen head. The grounds and waste put out from the *samshoo* distilleries, flour mills, bean curd manufacturers, etc., are used for pig-feed.

A rough calculation of the total number of pigs names 3,550,000 head for Fengtien province, 1,250,000 head for Kirin province, 490,000 head for Heilungkiang province, and roughly 1,000,000 head for the Eastern Inner Mongolia, the grand total being placed in the neighborhood of 6,690,000 head.

In Manchuria, there are three classes of the pig. One kind is larger-sized and weighs some 292-lb. when 2½ years old; another kind grows to weigh 150-lb., when a year old, and is known as smaller-sized; the other is medium-sized. Each kind breeds fast, and brings forth a litter of young numbering from ten to twenty at a time. The pigs' hair is coarse and long and is known as bristle, being a product of no mean importance. Bristle is exported abroad to be made into brushes. Most of it goes to Osaka, Japan.

How Domestic Animals are Tended.—As stated previously, the domestic animals raised by the natives receive but a nominal amount of attention. Cattle other than milch cows, horses and mules are kept either in roughly-made sheds or in the open yard. Millet straw is generally used for feed and is often given, mixed with maize stalks, straw, bean stems and grass. For richer feed, *kaoliang*, bean cake, wheat bran, etc., are added.

The Mongolians never build stalls or other shelter for their domestic animals, but leave them to look after themselves.

Some Chinese furnish shelter, but seldom provide for bedding.

Pigs kept by the Chinese farmers are let loose in the daytime, and are put in the pen at night. The sight of lively pigs frisking after feed in the field after the crops have been harvested is one of the quiet rustic scenes in Manchuria. In winter, pigs are sometimes fed on hay laid by for them, but in the majority of cases, they are left to themselves to pick up feed.

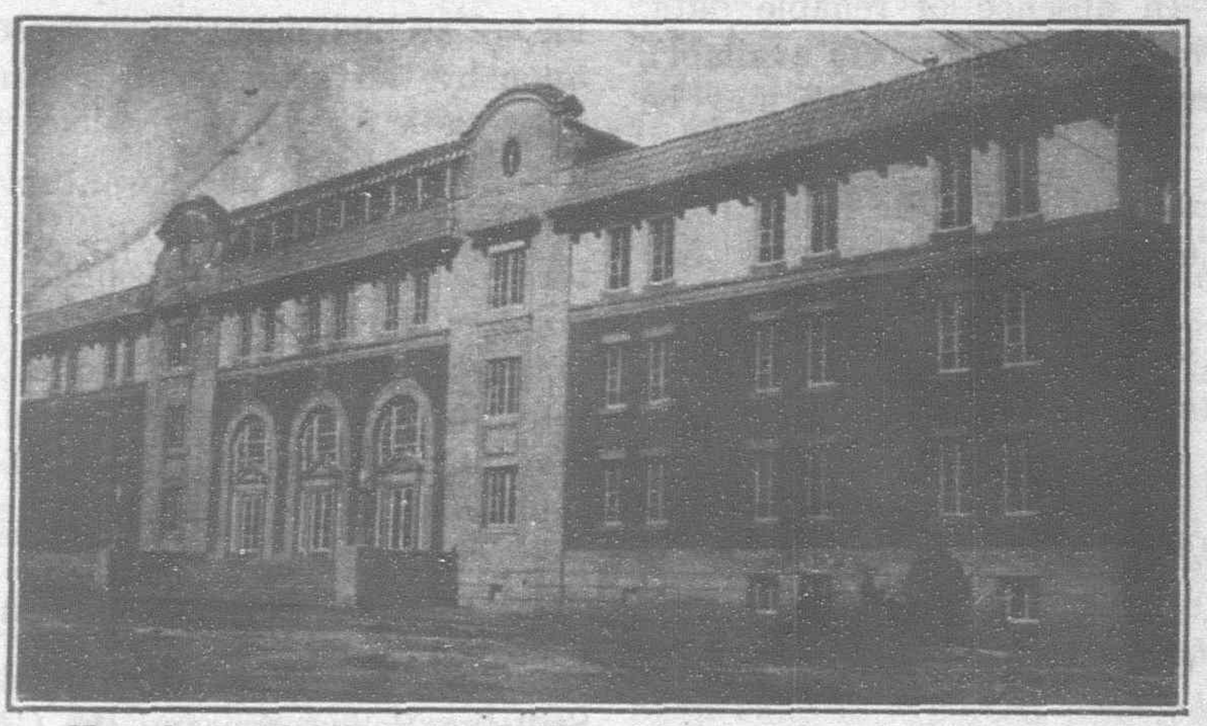
The Mongolians seek lowlands in summer for water for their sheep, and in winter get behind the hills for shelter from the piercing wind.

The sheeps' skins clothe the Mongolians; their milk and meat serve as staple food-stuffs; and the wool is used to cover the huts and keep off the draught. Sheep to the Mongolians supply clothes, food and shelter.

Exports of Stock-Farming Products.—As already stated, Manchuria and Mongolia abound in domestic animals, and wool, hides and leather, animals' bones, bristles, cheese and other dairy products are put out in a great variety and quantity. But, the methods of production remain all primitive and none of them have yet developed beyond the stage of a domestic industry. There is plenty of room for future development in this direction.

The following are the exports from Manchuria during 1918:—

Domestic animals, including cattle, horses, mules, pigs, sheep, etc.	Tls. 527,825
Wool, goats' hair, etc.	461,131



How the South Manchuria Railway Company houses its Employees

Top and centre: Offices and Quarters at the Azan Iron Mines and Steel Works.

Bottom: Batchelor Quarters at Dairen.

	T!s.
Bristle and horses' hair	353,309
Leather and hides and manufactures	787,099
Eggs	143,710
Animal oils	461,895
Animal's bones	129,367

IV. Forestry

DISPOSITION OF FORESTS.—In South Manchuria, the foot of the Changpai mountains along the upper reaches of Sungari, the Mutan and the Tumen, and also the upper parts of the Yalu and the Hun are densely wooded; while in North Manchuria, the districts about Hailin on the eastern section (between Harbin and Pogranichnaya) of the Chinese Eastern Railway and about Sansing in Kirin province are the principal forest lands.

On the other hand, Mongolia is a vast plain consisting of level land grown with grass and dotted with dunes. Nothing like a forest can be seen. Only amongst the Hingan range and the Yinshan range, there are believed to be some forests worth tapping, but no definite data are obtainable.

PRINCIPAL KINDS OF TREES AND THEIR PERCENTAGES.—So far about 300 kinds of trees are known in Manchuria and Mongolia, but the principal kinds number about twenty.

All the forests and woods being natural ones, the percentages of the different kinds of trees are subject to variance, but the conifers and the broad-leaved trees may be approximately placed at the respective rates of 40 per cent. and 60 per cent.

Of the conifers, the L. d. var. principis-rupprechtii R. et W. takes up the major portion; the A. nephrolepis, the P. hondœnsis Mayr., and kindred kinds 30 per cent., the minor remainder being divided among the rest.

Of the broad-leaved trees, the Q. Fabri Hance, Mongolian oak, T. Koreana Nakai, elm, poplar and their kindreds occupy some 70 per cent., the walnut, phellodendron amurense rupr., and such like being found in a meagre quantity.

In the forests of the Hingan range in the west of Heilungkiang province and in the north of Mongolia, the L. d. var. principis-rupprechtii R. et W., P. silvestris L., and B. japonica Sieb. (B. alba L. var. vulgaris D. C.), predominate, and there are found only few kind of superior trees.

FOREST AREAS AND ASSETS.—In absence of reliable data, nothing definite can be set down, but from all reports available, the forest areas and their assets in Manchuria for 1918 may be roughly as follow:—

(*a*) On the right bank of the Yalu and along the Hun River; 2,004,000,000 *tsubo* with 347,655,000 *koku* of timber, at 520 *koku* per 9,000 *tsubo*.

(*b*) On the upper parts of the Sungari, the Mutan and the Tumen excluding such localities as have only a few hundred *koku* of timber (according to the investigations of the S. M. R. Co.); 5,892,000,000 *tsubo* with 1,315,519,000 *koku* of timber, at 670 *koku* per 9,000 *tsubo*.

(*c*) Along the eastern section (between Harbin and Pogranichnaya); 7,305,000,000 *tsubo* with 924,696,000 *koku* of timber, at 380 *koku* per 9,000 *tsubo*.

(*d*) About Sansing district; 15,873,000,000 *tsubo* with 2,816,602,000 *koku*, at 495 *koku* per 9,000 *tsubo*.

(*e*) As to the forests in and about the Hingan range, no data can be obtained, except that in the district within the radius of about 30 miles around Horgo and Hingan stations for the centres, the average timber asset is put at about 450 *koku* per 9,000 *tsubo*.

Remarks: 1 *koku* is equivalent to 20 cubic feet.

TIMBER INDUSTRY.—The timber industry of Manchuria and Mongolia may be practically merged into the felling and utilizing of conifers. A great deal is exported to Tientsin as building material, but what is used for making coffins goes up to a considerable amount. As to the utility of broad-leaved trees, they are used for railway sleepers, mine timber and firewood, and for the making of charcoal, and little of them is employed for other industrial purposes. As timber markets, Kirin and Antung come foremost, followed by such consuming centres as Harbin, Changchun, Fengtien (Mukden), Dairen, etc. At Antung the Yalu Timber Company under Sino-Japanese joint management is located. Kirin has been a well-known timber centre from old times. At present there are divers Japanese and Chinese organizations engaged in putting out timber. Next, along the eastern section of the Chinese Eastern Railway, the railway management and Russians and Chinese have had railway sidings built to their lumber yards and are carrying on timber industry, including the operation of saw mills. With regard to transportation, both Kirin and Yalu timbers are carried down the rivers, whilst North Manchurian outputs are transported by railway. North Manchurian timber is usually 21-ft. in length, and Kirin timber is rafted down the stream in logs, the usual lengths being 15-ft. and 24-ft. As regards Antung lumber, ordinarily it is rafted down with two sides thereof stripped of the bark and roughly 16-ft. and 24-ft. lengths are most common.

TIMBER DEALERS.—In Dairen the leading timber dealers include the Mitsui Bussan Kaisha, Ryoto Timber Co., Yamaba Yoko, Dairen Timber Co., Kwantung Timber Co., the branch of the Akita Shokai, etc.

There are at Fengtien (Mukden) the branch of the Yalu Seizai (Saw Mill) Co. that of the Akita Shokai, the Mitsui Timber Yard, etc. The chief dealers at Changchun include the Manchuria Timber Co., Changchun Saw Mill, etc. At Kirin, there are the Mitsui Bussan Kaisha, Kirin Timber Co., the branch of Yalu Saw Mill, etc. At Antung, there are, in addilion to the Yalu Timber Co,, Yalu Saw Mill, East Asia Timber Co., Antung Saw Mill, Antung Timber Co., etc.

FORESTS AND THEIR POLITICAL BEARINGS.—In order to attend to the affairs concerning the forests, the provincial government of Manchuria have each the board of foresty which issues laws, regulations, etc. However, the foresty administration exists only in name, and forest fires, reckless disforesting, illicit disforesting, etc., occur in succession, and the depletion of the forests is growing worse year after year. It is partially because of the inadequacy of the Chinese police force and the bold operations of the brigandage, which render the steady exploitation of the forestry assests impossible. The high taxation in force on the forests, which are looked upon by the government as an elastic source of revenue, is also answerable for the yearly deforestation in a measure.

Apart from the Kwantung leased territory, all along the South Manchuria Railways, the hills have become bared of trees for the most part. This is highly regrettable not only from a forestry point of view, but from several other considerations. Only, it is gratifying to hear that the question of afforestation is beginning to interest the Chinese officialdom and people as well. The South Manchuria Railway Company has been distributing gratis yearly saplings of different kinds to the Chinese applicants.

V. Marine Products

The Kwantung leased territory has only short coast lines. Still the Yellow Sea and the Gulf of Pechili abound in fish of all kinds, and fishery industry is being carried on on an extensive scale. However, outside the Kwantung leased territory, there are no reliable statistics available. The more important kinds of marine products found in the Kwantung coast waters include the following:—

Tai, cod, sword fish, *guchi*, sawara, sole, flounders, *suzuki*, shark, *nibe*, sardines, *shirasu*, cattlefish, octopi, sea-slug, oysters, earfish, prawns, lobsters, crabs, whales, seals, etc.

FISHERMEN IN KWANTUNG LEASED TERRITORY.—The fishermen in the Kwantung leased territory are either Japanese or Chinese. The Japanese fishermen come from such prefectures in Japan as Yehime, Kumamoto, Kagawa, Oita, Hiroshima, Okayama, etc. They usually come over from Japan in spring and go home late in

autumn. There are about 200 odd fishing boats with some 1,500 fishermen, against about 16,000 Chinese fishermen. The chief hauls made by the Japanese are *tai*, and those by the Chinese are cod, *guchi* and swordfish.

The following are the figures for the past three years :—

	lbs.	
1917	25,135,150	Y.1,187,755
1918	25,631,675	1,617,493
1919	26,995,575	2,550,924

The whale-fishery about Haiyangtao Island, near which the naval battle took place in the Sino-Japanese war, is undertaken almost exclusively by the Oriental Whale Fishery Co. Few Chinese are interested therein. The catches are forwarded Shimonoseki way. Seals are captured on the ice-floes when the ice in the coast-waters break up on the return of spring in the north of the Yellow Sea and also in the north of the Gulf of Pechili. The annual hauls range between 700 and 800 head, and sometimes over 1,000 head.

Marine Product Industry.—The marine product industry still toddles in its infancy. Cod, *guchi*, mackerel, *nibe*, flounders, etc., are salted, and sea-slug, ear-fish, jelly-fish, shell-ligament, etc., are subjected to some preservation process by the Chinese. Some Japanese are turning out dried cod, and also working upon *tai* fish, but neither is worth mentioning.

Fresh Water Fishery.—The rivers, lakes and other bodies of water inland also abound with fresh water fish.

In the Yalu, the part about Antung affords a good fishing ground. In the Sungari, the parts about Wulakai on the Upper reaches, about Sanchiakou and farther below about Sansing are the most fruitful grounds. The lake in Hulun is one of the newest grounds. Among the fresh water fish, the carp, gibel, trout, salmon, wels, *suzuki*, *tanago*, *yamame*, *higai*, river-shark, etc., may be counted. In summer, the catches are carried to the market, and in winter, they are forwarded even into the interior of Siberia. The main and branch streams of the Sungari are known as pearl grounds, and a good deal is still being put out.

Salt Industry.—Over the Yellow Sea and the Gulf of Pechili, there is little rain and the evaporation process goes on actively. Therefore, the sea water is brinier, and salt manufacture is conducted very extensively along the sea coasts. Along those of Yingkou, Kaiping and Fuchou, the salt gardens under management of Chinese government and private parties lie in almost an unbroken line. The sea water is put in the salt gardens by making use of the tide and wind-mills, and is left to evaporation by the sun. Salt industry is conducted vigorously also in the Kwantung leased territory. The yearly outputs vary according to years, but are placed at about 3,000,000 *koku*, of which about 700,000 or 800,000 *koku* is put out in the leased territory.

Salt belongs to the monopoly of the Chinese government. The salt monopoly system is not unified all over China, but is more or less different according to provinces. In the three eastern provinces, the system is fashioned much after the Japanese system. The government buys salt manufactured along the sea coasts and sends it to different centres to sell it at the specified price. This system is comparatively well-organized. The import of no salt produced outside Manchuria is permissible into Manchuria. Smuggling is liable to severe punishment. Salt produced in Manchuria is debarred from export, except to Mongolia and the Jehol district. In the Kwantung leased territory, the area suited to salt manufacture is estimated at about 2,400,000 *tsubo*, of which only one-half is now operated. The Japan Salt Manufacturing Co., the Oriental Development Co., etc., are actively interested. When the export of Kwantung salt to Japan and Chosen increases, the outlook of the Kwantung salt industry will appear more promising.

VI. Industry

Rapid Growth of Japanese Industries.—Manchuria is richly endowed by nature with vast possibilities in agriculture, stock-farming, forestry, mineral products including fuel, and other industrial materials. Still, owing to the infantile stage of the Chinese in industrial or technical lines, there are few industries worthy of the name outside oil-expressing, flour-milling and *samshoo*-distilling. Even as to daily necessaries, the majority of them have had to be imported from abroad or South Manchuria. However, as the sphere of the Japanese activities has expanded in recent years, the abundance of raw materials and fuel (coal) and cheap labor have been turned to most account, and it has resulted in the establishment of a long list of industries, and thus the dawn of an industrial colony seems to be breaking on the Kwantung leased territo?y.

Chemical Industry.—Chemical industry, because of any supply of coal lying at hand and also because of the cheap electric power from the Mond gas producer plants being available, appears destined to thrive at and about Fushun. Actually, at the sulphate of ammonia factory attached to the Mond gas producer plant under management of the South Manchuria Railway Company, calcium carbide, calcium cyanide, sulphate of ammonia, etc., are being put out in considerable quantities. At Dairen, there are the Electro-Metallurgical Co., Manchuria Barium Industry Co. and Solite Manufacturing Co. (for the manufacture of solite, a paint made from soya beans). At Antung, there is the Manchuria Blasting Powder Factory. It is a pity that, despite the repeated experiments made for the production of soda from the plentiful Kwantung salt, the proposition has not yet assumed a tangible shape. In lines of oil and fat industry, the Dairen Oil & Fat Industry Co. is turning out hardened oil, etc., from soya bean oil, the Manchuria & Mongolia Development Co. dealing in gelatine, animal oils, and vegetable oils. In addition, the Manchuria Paint Co. is also located at Dairen.

Manufacturing Industry.—Bean milling ranks foremost in manufacturing industry. Bean oil is indispensable to the Chinese as a food and for cooking. Bean milling is best developed at Dairen, which is now possessed of sixty mills. In the interior of the country, the old primitive system by which a few head of mules or donkeys and a few hands do the work of expressing oil from beans is still found in vogue. Such is only a domestic by-industry. However, such extensive mills as use steam engines and express oil by hydraulic pressure are mostly found at Dairen. The Suzuki Bean Mill at Dairen is operated on the chemical extraction system which is the latest scientific method. The round-shaped cake left after the expression of oil weighs 46 *kin* a piece, which is the standard weight for export cake. In the fiscal year 1919, 19,693,000 piculs valued at Hk. Tls. 43,029,000 were exported to Japan. Bean meal, which is put out at the Suzuki Mill, is good for use as it is. Bean cake is used by the Chinese for cattle-feed, and by the Japanese as fertilizer. It contains a good percentage of nutriment sufficient to be made a food-stuff, and so the idea of converting bean cake into an article of food should not be pooh-poohed at as a fool's vagary.

The total outputs of the bean mills along the South Manchuria Railways in the fiscal year 1919 are placed at about 1,462,000 tons worth Y.99,800,000 in bean cake, and 151,000 tons worth Y.22,-650,000 in bean oil. Bean oil chiefly serves as material for the making of soap, oleomargarine and paints in the United States. Bean cake is exported principally to Japan. Distilling industry comes next in importance to bean milling in Manchuria. The liquors used by the Chinese in Manchuria are chiefly *samshoo* (distilled from *kaoliang*) and *huangchiu* (fermented from millet). *Samshoo* is the most popular drink and bears a slight resemblance to whisky. Fengtien (Mukden) and Liaoyang and their vicinities are the centres for *samshoo* distillation, although distilleries lie scattered all over the country. The aggregate yearly output of *samshoo* is estimated at Y.13,000,000, and no inconsiderable amount is exported to China. Recently there have been quite a number of people starting the manufacture of *sake* (a Japanese drink fermented from *sake*), *miso* an article of food, a necessary adjunct to breakfast in Japan which is made of beans, salt and *koji* (fermented rice), and *soy*. Japanese-made *soy* is superior to the Chinese-

made article in quality, and is believed to grow in demand amongst the Chinese.

The S. M. R. Co. general laboratory has invented an improved process of fermentation, and also how to manufacture calcium lactate from the grounds of *kaoliang* left after *samshoo* has been distilled.

Next, ceramic industry is still another indigenous enterprise that holds out a good promise. Manchurian soil is suited to ceramic industry. There are the Continenal Ceramic Factory at Fengtien (Mukden), the Asia Ceramic Factory at Kungchuling, the East Asia Brick Kiln at Dairen, and the branch kiln of the Yingkou Brick Kiln at Choushuitzu, in addition to like plants of more or less scale at Anshan, Kaiyuan, Changchun, Antung, Liaoyang, Ryojun (Port Arthur), etc. Most of these put out bricks and fire bricks. There are further numberless Chinese bricks kiln of modest scope.

South Manchuria, especially the Kwantung leased territory, abounds in limestone material for cement. The Onoda Cement Factory and the Dolomite Cement Co. are at Choushuitzu close to Dairen, and also a cement company is at Fengtien (Mukden). These factories have been doing prosperous business as the railway towns along the S. M. M. Co. lines have grown at a good pace.

As plenty of silicious rock is found to be glass-making material, there are at Dairen, in addition to the S. M. R. Co. Ceramic Experimental Institute, the East Asia Glass Factory and the Dairen Glass Co. The utilities of glass and glassware are not yet universally known among the Chinese inhabitants of Manchuria, but their manufacture is promising. For instance, the Ceramic Experimental Institute above mentioned has achieved satisfactory success in the manufacture of windowpanes and hollow ware both in quality and as a business venture, and before long a glass manufacturing company will be organized on an extensive scale under private management. In addition, with the war-time boon in iron foundry business, the Dairen Crucible Manufacturing Co. was brought into being. Then, pottery business is still another line of industry that promises to pay.

The pottery division which belonged to the Ceramic Experimental Institute was transferred to the China Ceramic Co. on October 1, 1920. Among those engaged in gathering clay and other raw material, there are the Japan-Manchuria Pottery Co., Manchuria Pottery Co., etc. Wulakai in Kirin province has enjoyed the name of a fine pottery centre from old times.

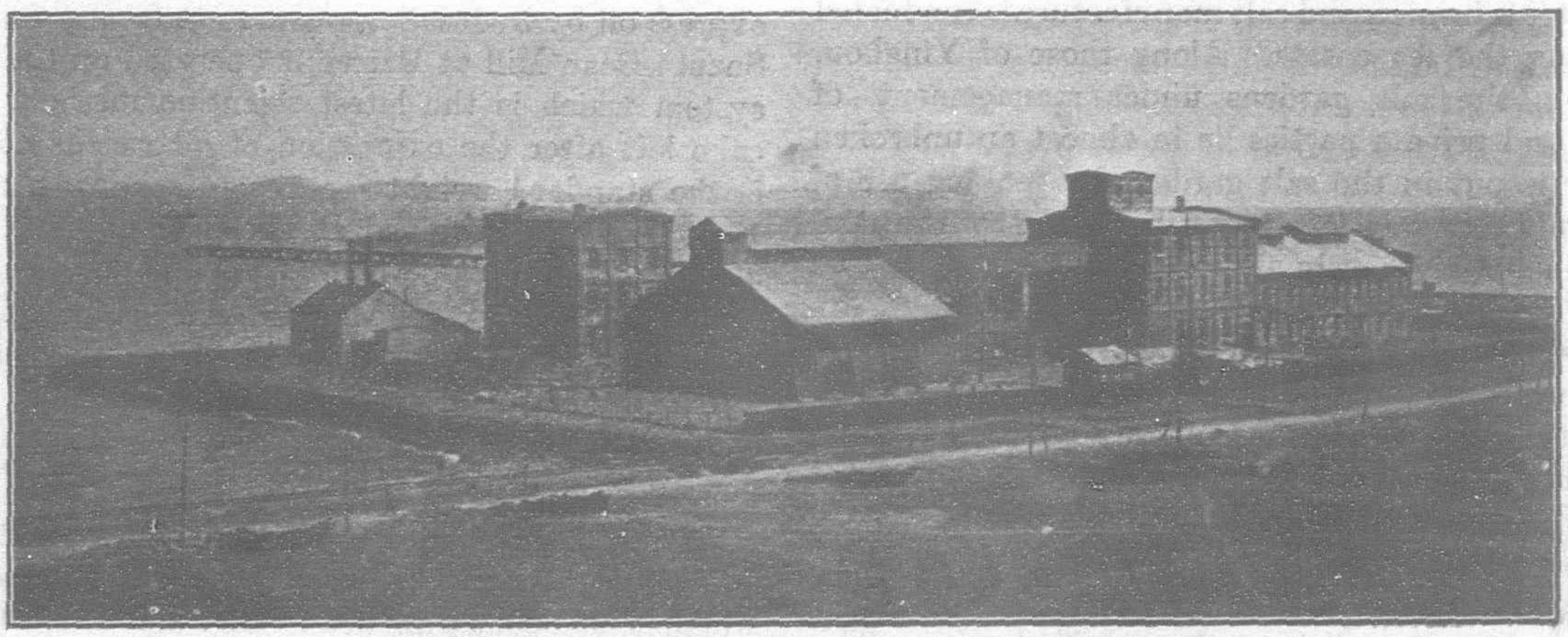
(To be continued.)

SOYA BEAN OIL

By Mr. M. Nakao & Mr. S. Ikebe (of the General Laboratory of the South Manchuria Railway Co.)

BEAN oil is made from soya (Manchurian) beans (glycine hispida maxim) which originated in China and have been transplanted in Japan, Chosen (Korea), India, etc. Manchuria is highly suited to the cultivation of beans, the aggregate production being estimated at between 12,000,000 and 18,000,000 *koku* (1 *koku* is equivalent to 4.96 bushels), of which, half is consumed by the bean mills, and the oil exported. The mills at Dairen consume over 500 tons a day.

Naturally, the study of beans, how to improve their breeds and unify them, and foretell deterioration in quality while in storage are matters of great interest and importance. The authors have been engaged in the study of these problems, but have not yet been able to complete them. The information in this article is only part of the results of their investigations.



South Manchurian Railway's Experimental Bean Mill

Classification of Beans and Bean Oil

The quality of oil depends on the class of beans from which it is made, and also on the process employed. The soya (Manchuria) bean has 214 species, which may be grouped under the following heads :—

Hairy : Hairless : (1) Flat, (2) Roundish, (*a*) Yellow, (*b*) Green, (*c*) Black, (*d*) Brown, (*e*) Greenish-Yellow, (*f*) Spotted.

These may be classified according to colors and ingredients and tabulated according to analysis, as follows :

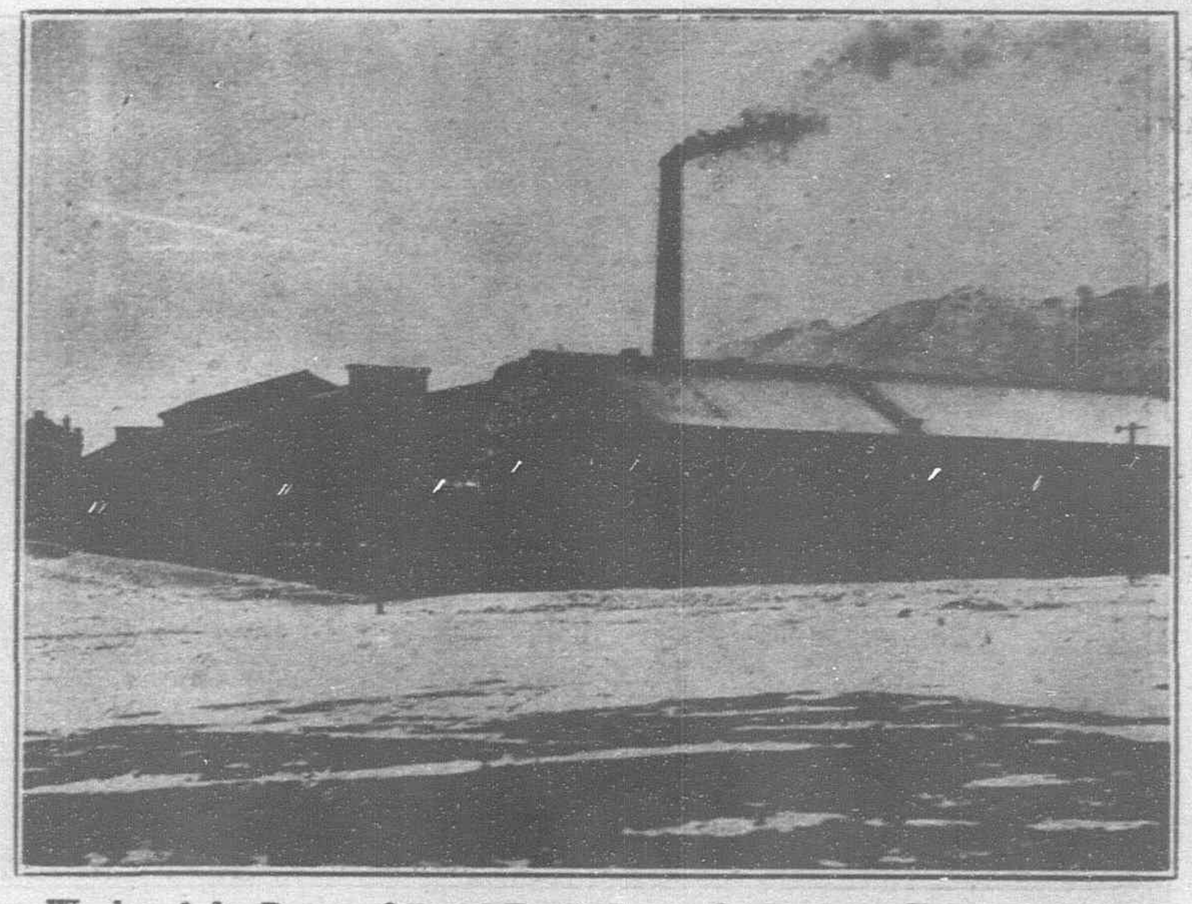
	Oil	Albumen
Deep blue	19.20%	45.55%
Blue	18.79%	43.13%
Light bluish yellow	20.81%	40.25%
Bluish yellow	19.95%	40.45%
Yellow	19.88%	42.54%
Whitish yellow	19.93%	41.81%

The above will show that the light bluish yellow kind contains the highest percentage of oil, and the blue the lowest percentage. All the yellowish kinds have much the same percentage of oil. Again, the results of analyses of various kinds of Manchurian beans confirm the above table in showing that the yellowish varieties contain the highest percentage of oil, blue a lower percentage, and the black, the lowest percentage. Allowances must be made for more or less variation according to places of production and in time of analysis. However, generally speaking, the yellowish varieties are the commonest and yield the greatest percentage of oil.

The results of the analysis are as under :—

Beans	Moisture	Crude albumen	Crude fat	Hydrocarbon	Crude fibre	Ash
Whiteeyed ..	9.87	37.23	9.37	24.03	5.11	4.39
,, ..	12.34	37.35	17.59	23.36	5.12	4.36
Chinyuan ..	9.70	37.74	19.33	24.41	5.05	4.77
Blackeyed ..	10.90	37.51	19.64	23.12	5.11	4.53
Yellow ..	9.11	39.90	17.59	24.27	4.92	4.21
Blue	12.64	36.47	16.23	25.08	4.89	4.69
Black . ..	10.74	35.32	15.80	24.43	5.96	4.00

Kodera Bean Mill, Dairen



Works of the Dairen Oil and Fat Industry Company at Dairen, where the oil is hardened, and glycerine, etc., manufactured

Expression of Oil and Bean Oil

Bean oil was formerly used as a source of light and a greater portion mixed with sesamum oil for cooking purposes. In such times, native mills on small scale could fill the local wants. But, since the utilization of bean cake as fertilizer, the bean mills manufactured the cake as the primary object, the oil being a mere by-product. However, as bean oil found an extensive market in Europe and America, the oil and the cake have now an almost equal demand. The process of expressing oil consists in expression and in extraction.

I. Expression

Oil expression may be subdivided into the wedge, the screw and the hydraulic pressure system.

(*a*) Wedge Method: The wedge method has been in use in China from early times. A wedge is employed to express the oil by hand, very primitive, and takes a long time. It is said that by this method, a comparatively large quantity of oil containing a less quantity of impurities is obtained. (*b*) Screw Method: In this method, the screw takes the place of the wedge to save labor. (*c*) Hydraulic Pressure System: The hydraulic pressure system is the most advanced of all and mills operated on this system are on the increase.

II. Extraction Method

In the extraction method, a solvent is used for the extraction of oil from beans. By this method, the largest percentage of oil is obtained. However, the oil procured by this system is of a different color from what is obtained by expression, and is dealt in separately. The extraction process extracts almost the whole of oil, whilst the expression process leaves nearly half the oil in the cake. The following table will be of some interest :—

Shape Principal Mills	Bean Cake round Everywhere in Manchuria	Bean Plate oblong Kabalkin Mill, Harbin	Bean Meal in meal Suzuki Mill, Dairen
Maximum pressure per square inch of surface	600-700-lbs.	1,700,2,200-lbs.	By benzine extraction
Oil percentage to beans ..	9-10%	11.5-12.5%	14-15 %
Oil left in residue	7-9%	5-7%	2.5-3.0%
Moisture contained in residue	12-19%	10-13%	4-13%

Literature on Bean Oil (Produced in Manchuria)

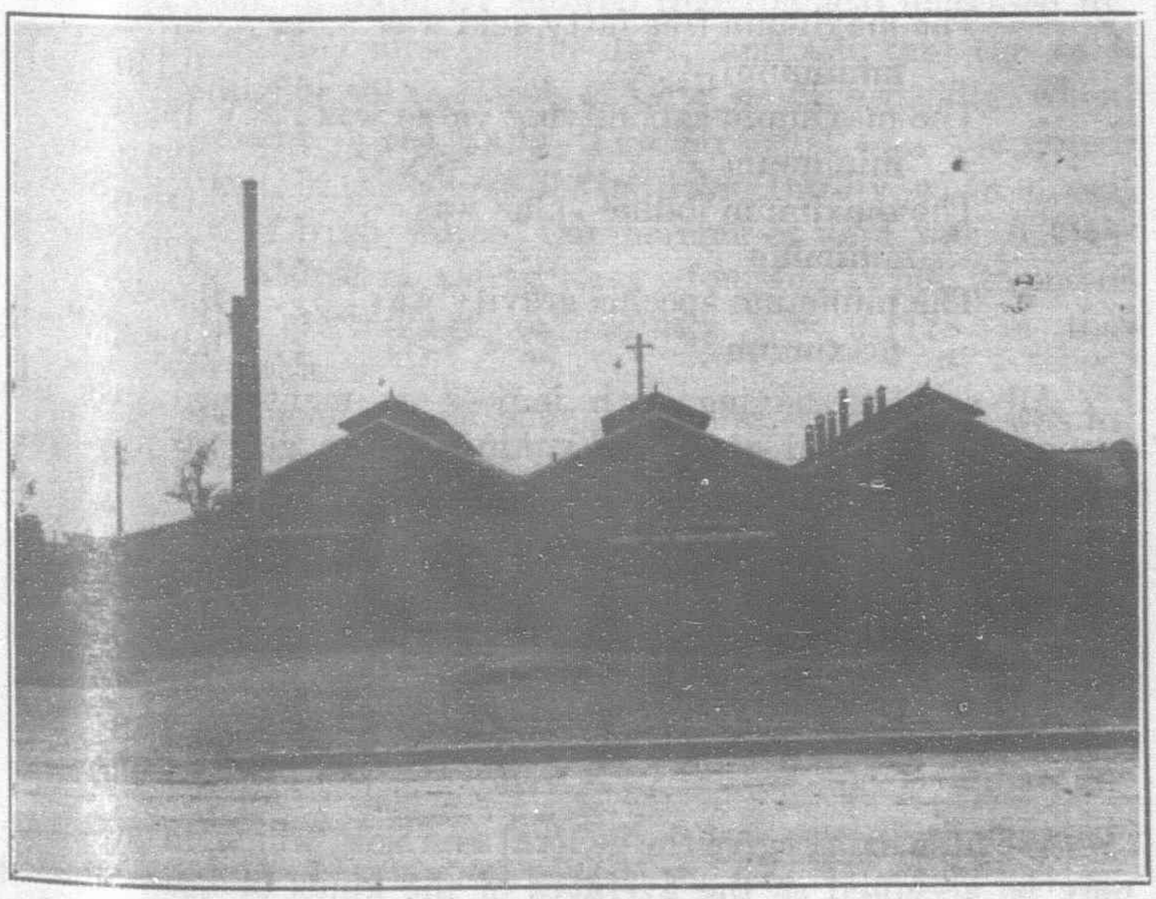
The study of bean oil has become popular with the increase in demand. There are a good number of books and articles written on this subject, giving the results of investigations made into the composition of beans and also their utilities. The following is a list of some of the more interesting writings on bean oil :—

Tsujimoto (in Vol. VII of 1904, Report of Industrial Chemical Society.)

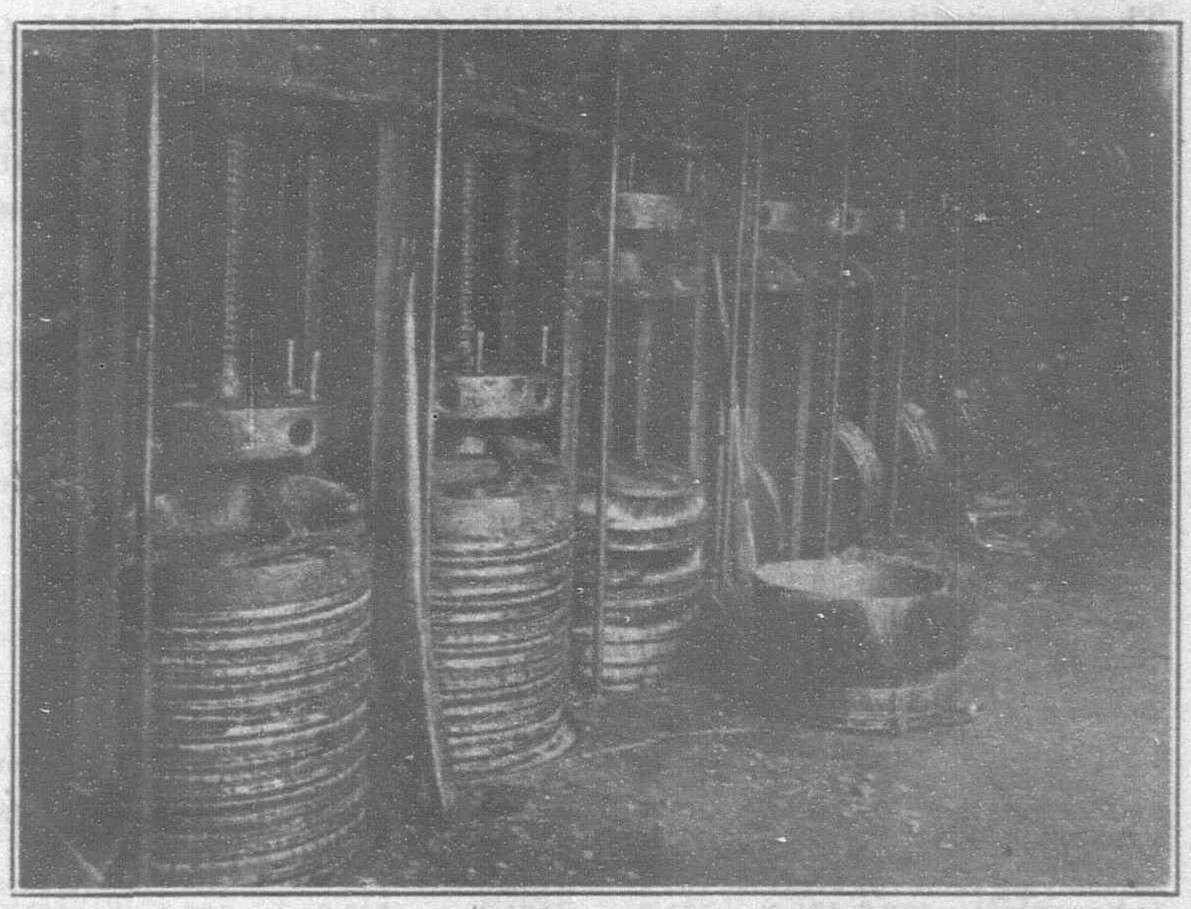
Kametaka (in Vol. XXVII of 1906, Report of Tokyo Chemical Society.)

Nishiyama (in Vol. XI of 1908, Report of Industrial Chemical Society.)

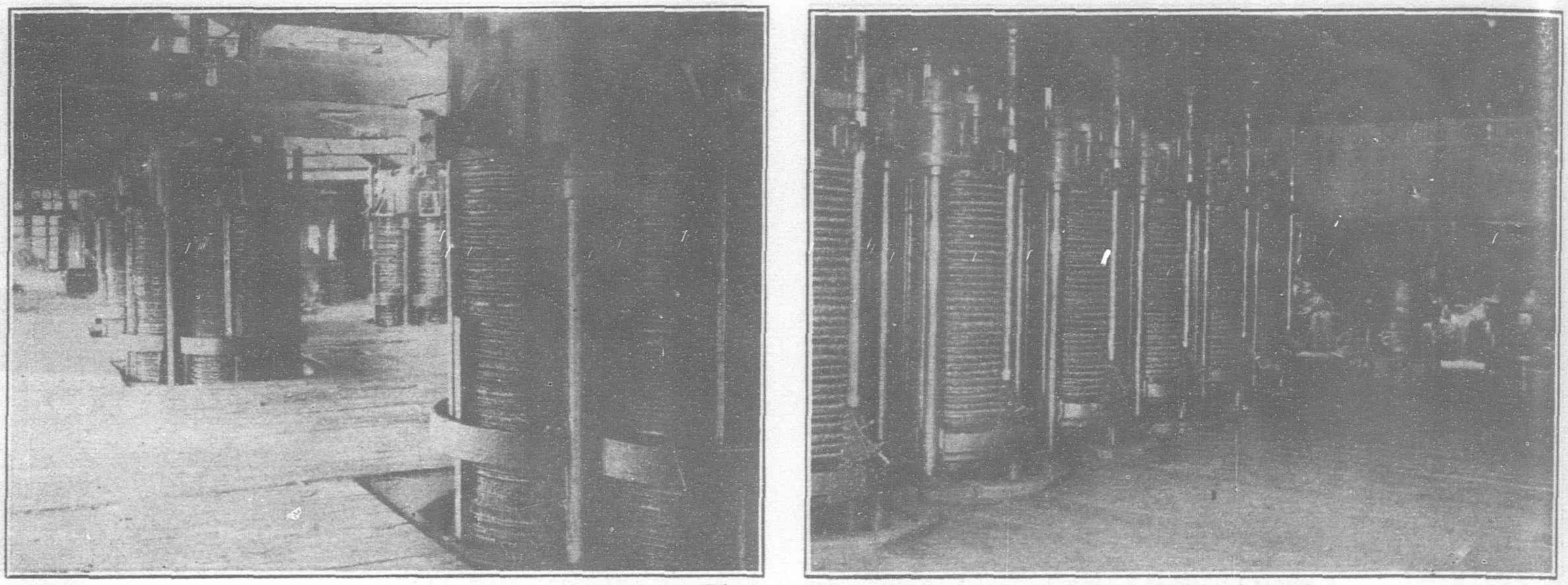
Uyehata (in No. 1, 1910, Report of S. M. R. Co. Central Laboratory.)



Nisshin Oil Mill, Dairen



Interior of the Nisshin Oil Mill, Dairen



Interior of the Santai Bean Mill, Dairen

Keimatsu (in Chem. Zeit, 1911, 8, 39.)

Okada (in Vol. 1, 1913, Report of S. M. R. Co. Central Laboratory.)

Nishiyori (in Vol. V, 1916, Report of S. M. R. Co. Central Laboratory.)

Sato (in Report of Industrial Chemical Society, 1919.)

Tanaka (in Report of Industrial Chemical Society, 1919.)

Uyeno (in No. 9, Report of Industrial Experimental Institute.)

Morawski and Stingl, De Negri, Fabris, and Schukoff.

W. Korentsehewski and Zimmermann ; Chem. Zeit. 1905.

Meister ; Chem. Rev. 1910.

C. Oettinger and F. Buchta ; Zeit. & Augen. Chem. 1911.

H. Matthes and A. Dahl : Tourn. Soe. Chem. Ind. 1911.

L. Settimi. Aun. Leb. Gebella, 1912-1913.

Brightmann ; Jon. Soe. Chem. Ind. 1919.

Charter A. Newhall ; J. Ind. Eng. Chem. 1920, etc.

In the above works and articles, Matthes and Dahl say that bean oil contains 94.95 per cent. of fatty acid ester, of which about 15 per cent. is saturated fatty acid, and about 80 per cent. unsaturated fatty acid. Olein acid takes up 70 per cent. ; linolic acid 20 per cent. ; and linolenic 6 per cent. Nishiyama claims that the unsaturated acid contains hypogene acid. Keimatsu says the presence of linolenic acid cannot be established. Tsujimoto doubts the presence of hypogene acid. Of bean oil, the percentage of non-saponifiable matter seems to widely vary according to places of production and oil-expressing methods. Dr. Riegel says that 0.15 per cent. of lechchin is contained. We have quoted above only a few fragments of the results of the ingredients of bean oil. They cannot be accepted as applicable to the quality of bean oil produced in Manchuria. Especially, as to the indices ascribed to Manchurian (soya) bean oil, opinions have differed. The indices given by Mr. Uyehata finds disagreement. Messrs Tsujimo and Mitsumaru aver that the value of Manchurian bean oil has been set too high.

The following is a table indicating the indices of the respective authors including our own :—

	Tsujimoto	Nishiyama	Keimatsu	Morawski & Stingl	DeNegri & Fabris
	(15°)	(15.5°)	(15°)	(15°)	(15°)
Specific gravity ..	0.9256	0.9242	0.9265	0.9270	0.9242
Freezing point ..	— 17° below zero		15°-16° below zero		—8°-15° below zero
Saponifying value ..	192.6	192.4	190.0	192.9	192.5
Iodine value ..	132.5	134.4	132-135	122.0	121.3
Hehner value ..	95.7	95.1	94.2	95.5	—
Reichert Meissl value	7.29	0.55	—	—	—
	—	96.0	—	—	59.0
	20°	20°	Viscosity		
Refractive value ..	1.4755	1.474	9.0	—	—
	20°		Engler degree		
Butter refractometer	75.2	—	—	—	—

	Oettinger & Buchta	Mathes & Dahl	Authors	Authors	Authors	Authors
	15°	15°	15°	15°	15°	15°
Specific gravity	0.9246	0.9240	0.9279	0.9289	0.9267	0.9278
Freezing point	8°–16° below zero	11.5° below zero	—	—	—	—
Saponifying value	192.4-194.0	192.3	190.0	191.0	192.3	190.8
Iodine value	132.9–135.0	131.3	131.8	132.0	137.7	134.8
			Wijs method			
Hehner value	95.8–96.0	94.07	—	—	—	—

	Acid value	Acid value	Acidvalue	Acidvalue	Acid value
Reichert Meissl value	0.45-0.59	0.75	0.57	0.72	0.18	0.09
	—	—	—	—	—	—
	(20°)					
Refractive value	1.47	—	Viscosity (Redwood) degree	Viscosity (Redwood) degree	Viscosity (Engler) degree	Viscosity (Engler) degree
	50-1.4755	—	274 (95°)	274 (95°)	8.43 (25°)	8.26 (25°)
Butter refractometer	—	—	72.5	72.5	71.8	71.8

The indices given in the above table have been obtained from only a few samples employed for experimental tests and furnish only a general idea. On this account, they are felt to be somewhat inadequate for all the varieties of Manchurian bean oil appearing on the market. Accordingly, in March, 1921, of three hundred odd bean mills at Dairen and along the South Manchuria Railways, 140 of the more important mills were selected, and samples of ordinary bean oil put by these plants were procured and subjected to a general test, particular attention being given to the color of the oil, which had hitherto been left neglected. This was done, because as an article of merchandise, the color standard must be observed, apart from the uniformity of quality from a chemical standpoint. Especially, in the tests to be passed on bean oil imported into America, its color forms an item of importance. It is laid down that no bean oil shall be darker, when $5\frac{1}{4}$-in. deep, than the mixture of either yellow (70) and red (8.0) or yellow (70) and red (9.0) of the standard colored glass. Bean oil manufactured in Manchuria seldom meets the above standard requirements. This point is held by us as one which calls for the serious study of the bean mill owners.

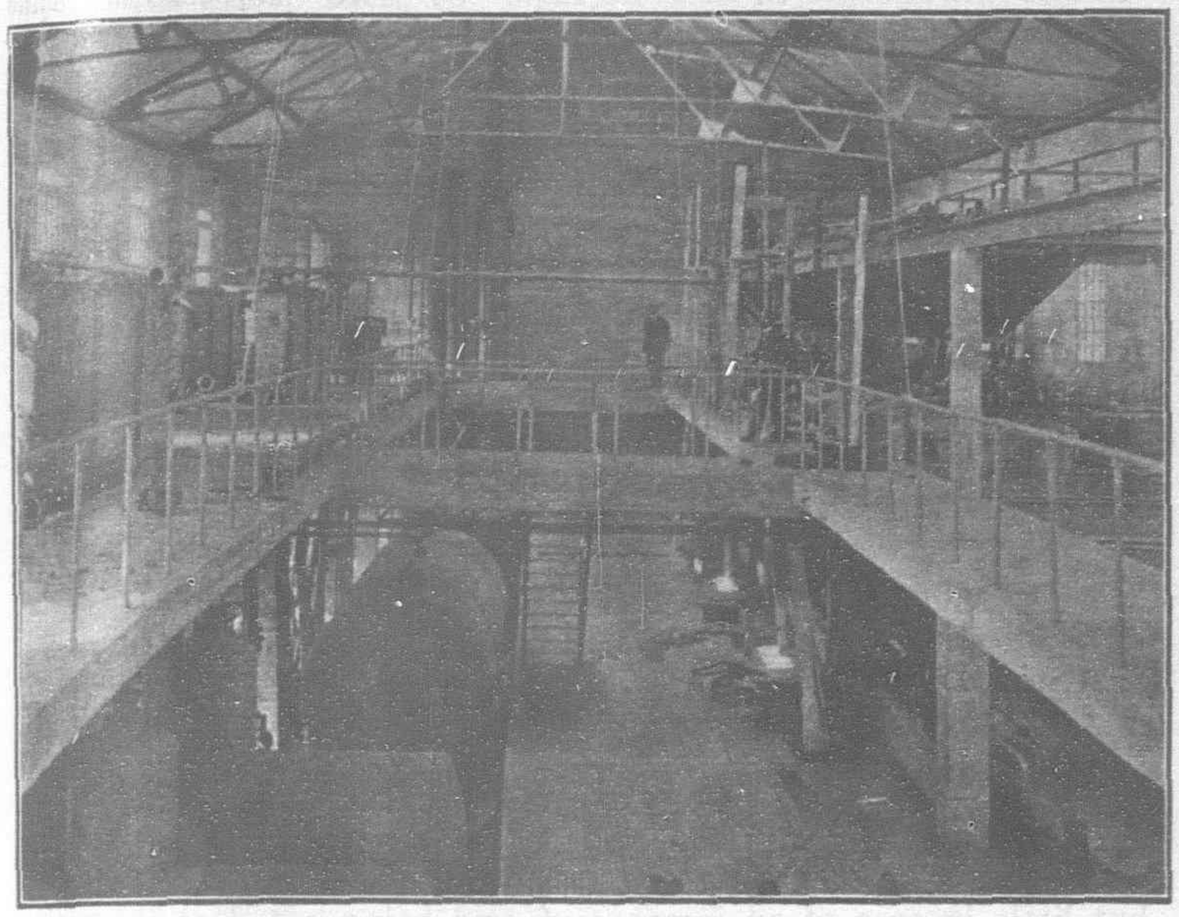
As a result of these exhaustive tests the following data was obtained :—

The maximum free fatty acid was	..	2.782
,, minimum ,,	..	0.140
The maximum saponifying value was	..	195.8
,, minumum ,,	..	188.4
The maximum iodine value was	..	140.0
,, minimum ,,	..	130.0
The minimum specific gravity was	..	0.9254
,, maximum ,,	..	0.9299

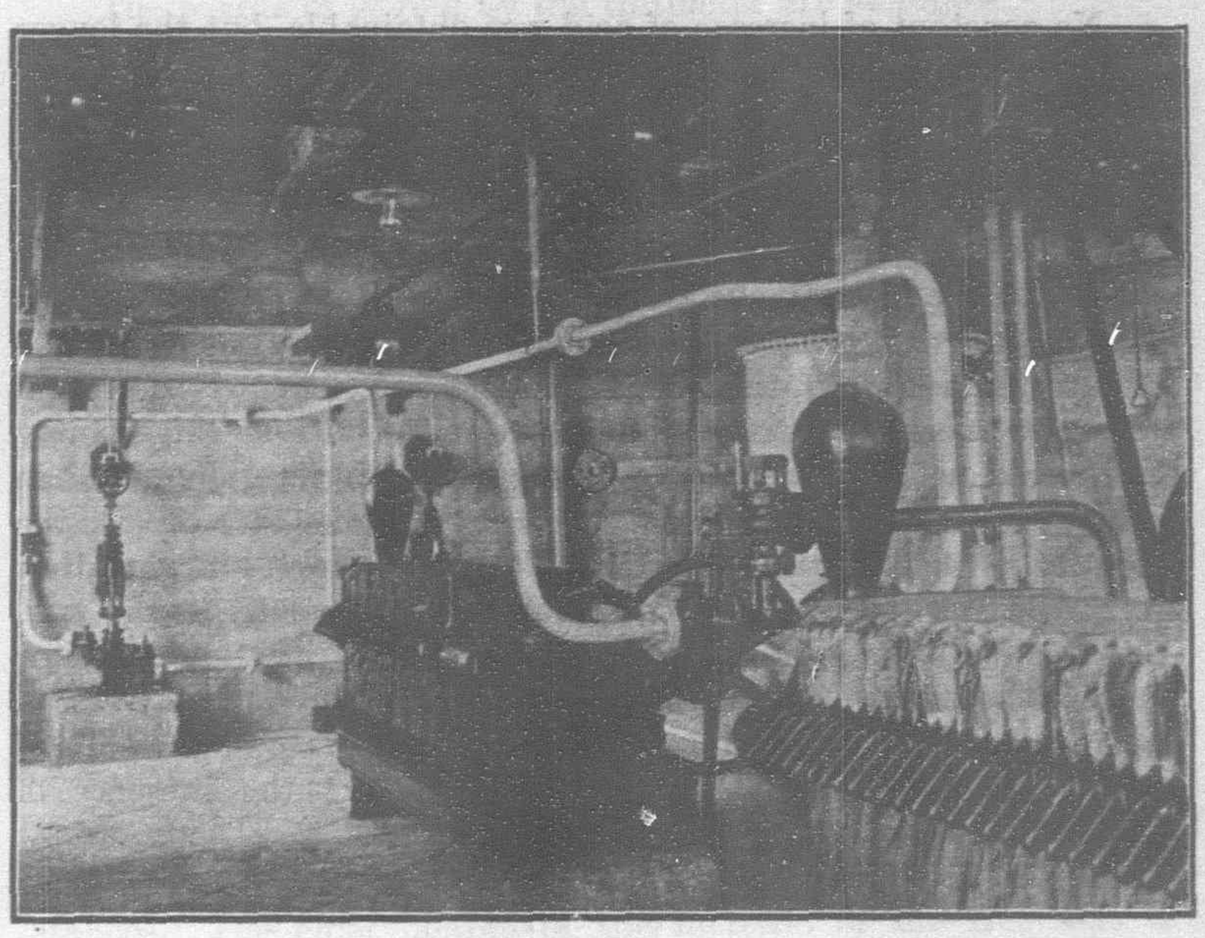
All samples having such indices as mentioned just above cannot be regarded as ordinary kinds. The general averages of all the samples are as under :—

Specific gravity ..	.. ..	0.9272
Free fatty acid ..	.. ..	0.4011
Saponifying value	.. ..	191.40
Iodine value ..	.. ..	134.44
Colour (2 inches deep) ; yellow	..	59.18
red	.. ..	6.85

These figures give the general averages, which, in our opinion, may be accepted as the averages of the kinds of bean oil on the market. As to the color standards laid down by the United



Interior View of Extraction Room



The Fitter Presses

States, they seem rather severe for the bean oil now on the market, and appear more worthy of refined oil. In fact, if more than two inches deep, the American color standards would seem too dark.

Free Fatty Acid of Bean Oil

Free fatty acid in bean oil is looked upon as important as color, as the percentage of free fatty acid influences the price. Especially, which oil for export, the percentage of free fatty acid is feared to be prone to increase while in transit. Of course, the acid value of bean oil varies according to new or old beans, from which it has been made, and also according to the length of time that has elapsed after its manufacture. The older the beans the higher the acid value. Messrs. Mathes and Dahl say (in Arch. Pa rm. 1911, 249. 424-435) that experience has taught that the moisture in the atmosphere raises the acid value.

Again, Mr. Nishiyama says, in No. 11 of the report of the Industrial Chemical Society in 1908, that exposure to the sun is found to increase the acid value of bean oil. The same author calculates the rate of increase as: 0.55 per cent. of acid value in bean oil rises to 1.01 per cent. on exposure to the sun for thirty days, and to 4.63 per cent. after ninety days. The same author has then studied if the acid value increases or not because of the presence of residue in bean oil, and has learned that such presence produces little effect. According to a report prepared in April, 1921, by the Kobe branch of the Mitsui Bussan Kaisha on the cause of deterioration of bean oil in quality, firstly, a sample of bean oil adulterated with 1 per cent. of impurity showed that the acid increased by 1.5944 per cent. in the course of fifty days, and also that the rate of increase rose higher till the lapse of forty days; secondly, when mixed with 1 per cent. of sea water, the increase of acid was noted to be 0.479 per cent. in the course of fifty days; thirdly, when mixed with 1 per cent. of fresh water, the increase of acid was 0.3948 per cent. in the course of thirty days; fourthly, when exposed to the sun, the percentage of increase was 0.1128 in the course of twenty days.

The degree of acidification among the above four cases was in the order mentioned, and in the fourth case, but little effect was discernible. The authors subjected samples of bean oil manufactured afresh at the factory of the Dairen Oil & Fat Industry Co., Dairen, the qualifications of which were as follow, to the undermentioned tests: Specific gravity 0.92 at 15° C; free fatty acid 0.143 per cent.; saponification value, 190.7; iodine value 132.2; moisture, 0.173 per cent. When oil is filtered, free fatty acid is put at 0.14 per cent.

These samples were left in different conditions as designated on the next column for thirteen weeks, the free fatty acid having been examined and measured once a week in the meantime.

	Maximum free fatty acid	Rate of increased acid	Progress
Crude oil (2 litres) (Stored in the dark)	0.1936	3.68	No increase of acid noticed after the fifth week.
Filtered oil (2 litres) (Stored in the dark)	0.1936	3.68	,, ,,
Crude oil (exposed to the sun)	0.2079	4.93	The weather conditions prevented a regular examination and measurement, but after the tenth week, no increase of acid was observed.
Crude oil (500 c.c.) (Stored in exsiccator)	0.1798	2.84	Acid increased very slowly, ceasing to increase after the ninth week.
Filtered oil (500 c.c.) (Stored in exsiccator)	0.1798	2.84	,, ,,
Crude oil (500 c.c.) (Stored in exsiccator saturated with moisture)	0.2628	8.79	From about the fourth week, the oil began to thicken from the surface; this became more pronounced in the thirteenth week, the increase of acid going on incessantly.
Filtered oil (500 c.c.) (Stored in exsiccator saturated with moisture)	0.2766	9.41	As above mentioned.
Crude oil (2 litres) (Stored in a heated room from 50 c to to 60 c)	0.3100	12.16	In a day, most of the precipitation became dissolved, the oil turning clear; the constant restored after three weeks.
Filtered oil (2 litres) (Stored in a heated room from 50 c to 60 c)	o.2766	9.41	No increase of acid observed after three weeks.
When dry air was sent in	0.1936	3.68	Little change noticed; the constant restored after four weeks.

As regards the variation in the increase of acid when oil is kept at a high temperature, the oil was kept in a drier at 105° C. for different lengths of time, and the free fatty acid was examined and measured, the results being as follow:

Left for	Free fatty acid: At beginning	Free fatty acid: At end	Rate of increase of acid to its inherent acid
2 hours	0.163	0.166	0.19
,, ...	0.164	0.174	0.59
4 hours	0.140	0.194	3.86
,, ...	0.163	0.102	2.39
,, ...	0.164	0.205	2.5
,, ...	0.140	0.166	1.8
12 hours	0.143	0.286	10.0
,, ...	0.183	0.302	6.7

No constant of increase of acid was obtainable, but the longer the oil under test was allowed to stand, the greater was the increase of the free fatty acid. It will be noted from the above results of the tests that (1) when either crude oil or filtered oil is kept from contact with air as far as possible, for instance, in an exsiccator, the rate of increase of acid was not marked; (2) the rate of increase of acid was comparatively low also when crude or filtered oil was kept in the dark; (3) the same held true when dry air was sent in. In the case of (1), the increase of acid was extremely slow, and after nine weeks, the constant was restored. From this it may be inferred as effective in preventing the deterioration of oil in quality to minimize its contact with air. In the case of (2), the quantity of acid became constant after five weeks, showing that storage in the dark is more desirable than exposure to the sun. Again, when oil is kept in a humid atmosphere, whether crude or filtered, the oil will absorb the mositure with more or less avidity, causing the oil to thicken and also raising the rate of increase of acid. It is patent what a deteriorating effect the presence of moisture has on the quality of oil.

As to oil stored at a high temperature, filtered oil shows a smaller rate of increase of acid, compared with crude oil. Still, the rate of increase is unmistakably higher than in other conditions. Such a contrast is all the more striking according to the lengths of time kept at a temperature above 100° C. These are phenomena resulting from the dissolution of oil, and it deserves special notice that the process of dissolution goes on more rapidly in water of normal temperature. Next, any impurity contained in crude oil, how small it may be in quantity, when it acts catalytically, was considered as a cause of the increase of free fatty acid, and some crude oil with all its impurities and some filtered oil were left untouched for a long time, to determine their respective acid values.

The above mentioned both samples were stored in the dark, and if any precipitation was found to settle, it was shaken well, and then a sample was obtained for examination and measuring.

	Free fatty acid		
	In crude oil	In filtered oil	Rate of acid value
At beginning ..	0.2484	0.2000	1.5 : 1
After 4 weeks ..	0.4703	0.2143	2.2 : 1
After 8 weeks ..	0.8783	0.2282	3.9 : 1
After 12 weeks ..	1.1756	0.2351	4.9 : 1

According to the above, oil, when once filtered, compared with crude oil, shows little increase in the free fatty acid. On the contrary, in the case of crude oil, at the end of 12 weeks, the quantity of acid is found to rise to fivefold, perhaps due to a catalytic solution. For this reason, when bean oil is to be stored in a large quantity for a long period, it ought first to be cleared of what impurities are contained by filtering.

Moisture and Bean Oil

We have learned by experiment that the dry air affects bean oil just a little, and that the moist atmosphere is prone to cause deterioration in the quality of bean oil. Again, we have brought some bean oil on sale on the market into contact with dry air after the oil has been filtered, and also into contact with moist air after letting the air pass through water. These experiments have been conducted in order to see what effect, if any at all, may have been produced on the saponification value and also iodine value.

It has been found that dry air does not cause any change in the oil, while, on the contrary, moist air increases the acid value, causes the oil to thicken in the fourth week, makes it more turbid in the fifth week, cause it to emit an acidifying smell like the odour of bird-lime and increases the settlings from the seventh week, and in the tenth week, the decomposing process goes on so actively as to make it difficult to obtain any two samples of the same quality.

	Moisture	Free fatty acid	Saponification value	Iodine value
Bean Oil	0.141	0.4426	190.8	134.3
After dry air has been sent in for five weeks	0.141	0.4426	190.2	134.3
After moist air has been sent in for a week	0.3360	.4444	193.4	133.4
After moist air has been sent in for five weeks	0.345	0.5255	191.4	131.2
After moist air has been sent in for ten weeks	0.606	0.6274	190.3	132.2

The indices for the samples of bean oil subjected to the test are as under :—

	Saponification value	
At beginning	191.0	132.7
Stored in the dark	190.8	132.8
Stored in dry air	191.0	132.6
Stored in saturated moisture ..	191.2	135.0
Stored in hot air	191.0	133.2
When dry air is sent in . ..	190.7	132.5

From the above, the saponification value of bean oil is affected but little in case of an increase of acid being noted or otherwise. On the other hand, on the whole, the value is observed to increase when the oil under test is subjected to a high temperature or is brought to contact with moisture. These results contradict the conclusion drawn by Messrs. Mathes and Dahl who say from experiments that moist air always lowers the iodine value. This point awaits further investigation.

Receptacles and Bean Oil

Nothing has yet been said about the effect of the receptacle, in which bean oil is packed, on the appearance of the contents.

However, when bean oil is kept in a glass vessel, which is liable to generate alkali by solution, the free fatty acid is known to decrease in value when left therein for some time from the original quantity.

Next, some kinds of receptacles get eroded through the impurities in the oil, threatening at times to deteriorate the quality of the oil. In our cases, the samples have been obtained from bean oil on the local market, packed in oil tins. In order to ascertain whether or not any change will take place in the amount of the free fatty acid, when stored in a glass bottle and also in a tin can, the oil in the two different kinds of receptacles has been left to stand for eleven weeks, but no change has been indicated in the amount of fatty acid, as shown under :—

	In glass bottle (1 litre)	In tin can (about 1 litre)
Free fatty acid at beginning ..	0.4986	0.4986
After one week	0.4979	0.4979
After five weeks	0.4978	0.4978
After ten weeks	0.4978	0.4978

Next, 1 litre of ordinary bean oil on the market has been put in three different kinds of receptacles (A) a galvanized metallic vessel, (B) a vessel made of iron plate, and (C) a vessel made of tinplate. At the close of each week succeeding, the oil has been examined, giving the following data :—

	Free fatty acid	Saponification value	Iodine value	Ash	Remarks
At beginning	0.7449	191.9	132.9	0.039	Moisture 0.107 ; Specinc gravity 0.9264
At end of 1st week ..	0.7746	—	—	—	
Vessel A	0.9192	190.9	131.8	0.04	No special metallic reaction shown in ash
Vessel B	0.7606	190.3	132.6	0.035	,,
Vessel C	0.7746	190.3	132.7	0.04	,,
At end of 2nd week ..	0.7883	—	—	—	
A	0.6777	190.8	132.3	0.04	,,
B	0.7381	189.6	132.9	0.04	,,
C	0.7883	190.8	131.5	0.04	,,
At end of 3rd week ..	0.8460	—	—	—	
A	0.6912	190.4	132.3	0.045	,,
B	0.7380	190.1	132.0	0.038	,,
C	0.8022	191.8	132.3	0.040	,,
At end of 4th week ..	0.8714	—	—	—	
A	0.6569	190.7	132.3	0.048	No special metallic reaction shown in ash. Specific gravity, 0.9264
B	0.7469	191.9	132.8	0.04	,,
C	0.8443	191.9	132.1	0.039	,,

In the above tests, the bean oil used as standard showed an increase in free fatty acid from 0.7449 per cent. at the beginning to 0.8714 per cent. at the close of the fourth week.

Next, looking over the samples of bean oil kept in the three different kinds —A, B, and C—the contents of A indicated a decrease in free fatty acid ; those of B gave a like result ; and, as to those of C, no change was observed. In the case of A (a vessel made of galvanized metal), the surface was noticed to come off gradually as weeks went by, producing a precipitation, chiefly zinc. This decrease of the acid value, as instanced in the above table, is now under investigation. It is perhaps due to the fact that the free fatty acid has combined with the metal dissolved by electricity and has formed a salt. In fact, the coming off of the zinc seems to bear out such theory. Especially, the change of color of bean oil is more notable, as is denoted under :—

Bean Oil, 2 inches deep, measured by the Robibont Tintmeter

	A (galvanized metal)		B (iron plate)		C (tin plate)	
Standard glass	Yellow	Red	Yellow	Red	Yellow	Red
Bean Oil for test ..	61.2	7.0	61.2	7.0	61.2	7.0
At end of 1st week ..	62.2	7.0	81.4	4.6	57.5	6.8
2nd ,, ..	64.1	6.6	110.4	1.3	60.5	6.8
3rd ,, ..	62.2	6.5	118.0	1.6	60.2	6.6
4th ,, ..	62.2	6.5	120.2	1.6	57.8	6.6

It must be noted that the above data have been obtained as the result of only one experiment, whilst further experiments ought to be conducted to confirm the same. In the cases of A and C, little change has been observed, a tendency of fading even being noticed. On the other hand, with B, the color has been found to darken perceptibly.

Precipitations and Bean Oil

It is well known that the storage of bean oil expressed afresh produces a precipitation. In ordinary circumstances, the precipitation is put at 1 per cent. of the storage amount. We left bean oil just expressed in a long glass tube. The floating matter was slow to settle, and it took about four weeks for it to get practically precipitated, and, at the close of the fifth week, the oil became a clear liquid of uniform color. The settlings amounted to 1.26 er cent. of the dimensions of the oil, and, if dried, they were found to be 0.09. When the oil is freed from the settlings, no further precipitation is formed unless the oil contains water or other impurities.

The settlings have been obtained from the Nisshin Oil Mills, Ltd., Dairen (Mr. J. Furusawa, managing director) and been subjected to analysis, the results of which being as follow :—

Water	14.05
Ether lixivium	46.98
Crude albumen	2.75
Other organic matters	32.65
Ash	3.57

In order to neutralize 10 grammes of bean oil, 9.96 grammes of caustic potash is required. If this is included in the calculation as olein acid, the oil amounts to 50.18. About half the settlings consists of fatty acid ; the other half consists of water, minerals, albumen and other impurities, which make factors to lower the quality of bean oil. As already stated bean oil, when filtered and free from the settlings, is less liable to get deteriorated than crude, oil, and on this account, for the storage of bean oil, the removal of these settlings is necessary.

Conclusion

We may add that the 140 samples of bean oil, above mentioned were obtained from the bean mills without the mixture of any other substance. However, there were sixteen kinds suspected of the mixture of some blue bean oil.

The results of gaging by the tintmeter are as follow :

	Blue bean oil		Ordinary bean oil	
	Yellow	Red	Yellow	Red
Maximum ..	187.5	8.6	55.0 or 91.5	12.0 or 8.8
Minimum ..	109.0	1.6	23.0	5.75
Average ..	106.8	4.4	59.18	6.85

The above table will serve as guide to deciding whether or not a sample of bean oil is an ordinary kind or blue bean oil. In the case of an ordinary kind, the yellow seldom rises above 70. What is near 100 may be regarded as an inferior kind and wears a dark color.

As to the chemical indices, such as denoting :—

Specific gravity	0.9272
Free fatty acid	0.4011
Saponification value	191.04
Iodine value	134.44

may be accepted as ordinary kinds.

In bean oil, the free fatty acid markedly increases to the end of the fifth week after its expression, but thereafter the rate of increase is observed to be very slow except under special circumstances. The chief factors of the increase of the free acid are moisture, a high temperature and precipitates. Bean oil which has been eliminated of these impurities shows a less marked change.

Speaking of the receptacles, in which bean oil is to be packed, some of them will cause more or less discoloration. An iron vessel, which is rusty, is the worst and should be carefully avoided. When bean oil is to be stored in a large quantity, care should be given what kinds of vessels they are to be kept in. Next, the removal of all impurities and water is the most important. In conclusion, we are pursuing our experimental study of bean oil and also how to decolorize blue bean oil or such as has some of it mixed, and also how reduce the acid value of such as has an excess amount of free fatty acid, and we may have an opportunity to publish the results of our further investigations.

Japan's Condensed Milk Industry

THE condensed milk industry in Japan, like so many other enterprises which found their reason for being in the prosperity of the war period, fell into evil days after the armistice and has as yet been unable to recover from its difficulties.

Before the war the condensed milk industry in Japan was very insignificant. Naturally so, because, there were very few cows to supply any reasonably adequate quantity of milk for the factories. The greatest part of the condensed milk used in Japan came from Europe and America, only 30 per cent. of the consumption being produced in the domestic factories.

Shortly after the war began, imports fell off and demand increased abroad. In order to build up the primitive industry the government granted many exemptions from taxation to condensed milk companies. In 1915 and 1916, therefore, it began to grow, and in 1920 there were more than 30 factories in Japan.

Comparatively Great

Even at the height of the war prosperity production was insignificant compared to the European or American industry, but considering Japan's lack of pasture grass, and milch cows, it was comparatively great.

In 1912 production was 2,113,290 *kin*, growing as follows : 1914, 3,188,587 *kin* ; 1917, 7,538,560 *kin* ; 1918, 10,821,043 *kin* and 1919, 16,902,994 *kin*.

From 1914 to 1919 the increase was five-fold, but from 1920 business has fallen off, and production consequently decreased and the future prosperity of the whole industry is extremely problematic.

Assisted Greatly

Only under the beneficient shade of the great war and by means of government protection was it possible to develop this industry to its past greatness. The government put an import

tax on foreign condensed milks of Y.5.50 per 100 *kin*, rescinded the domestic consumption tax on sugar, on all sugar used in condensed milk manufacture, and for three years from the date of establishment of a condensed milk company exemption from all taxation was granted. All these governmental aids were necessary to start the manufacture even, and it cannot be wondered at that its foundation is therefore decidedly weak.

Thirty Companies Now

To-day there are 30 companies engaged in producing condensed milk but their combined capital is not more than Y.5,000,000. Three companies, the Toyo Condensed Milk Co., capitalized at Y.1,500,000, the Kona Milk Co., Y.1,000,000, and the Boso Condensed Milk Co., Y.1,100,000, account for the greater part of this total. All the other companies are small, T.50,000 being a large capital for any one of them. It can readily be understood therefore that the equipment of these factories is decidedly inadequate and production can only be on a very small scale.

Each of these petty companies has registered dozens of trademarks and consequently there are many competing brands of condensed milk on the market for the limited domestic trade.

Double Competition

Not only is there cut-throat competition in buying but the principal raw material, milk, is extremely limited in quantity, so they are all competing against each other to get supplies on which tocontinue production. So the price of milk is driven up, and naturally their products must be sold at high prices.

Manufacturers of condensed milk proudly say that they are making very good condensed milk indeed, and that imported milks will soon be driven off the market by their efforts, but even at the time when foreign milk was most scarce in the domestic market, Eagle Brand (American), and Nestle's brands (Swiss) were not driven out by the home-made product.

Imports Resumed

Since the peace released European and American condensed milks for export, Japan has been importing more and more of them every year. The quality of the European and American manufactures is unquestioned abroad, while Japanese condensed milk exported during the war earned a poor name, and there is no market abroad now open to it.

Comparative Figures

Imports and Exports of Condensed Milk were as follows:

	Imports *kin*	Exports *kin*
1913	6,969,482	——
1918	3,233,976	1,307,350
1919	4,060,950	4,701,388
1920	4,701,388	——
1921, end June	3,073,388	54,838

In 1920, from January to June inclusive, imports were 2,158,188 *kin*, and in 1919 during the same period they were 2,291,627 *kin*. It can be seen how imports have increased this year.

It can readily be seen that competition with American and European brands has dealt a terrible blow to the Japanese industry. Certainly the Japanese manufacturers cannot continue to produce as they have in the past, especially as now selling competition is getting worse and worse in the extremely limited home market, and export is dead.

Dividends Disappear

The profits of companies is getting lower and lower. The Toyo Condensed Milk Co. was organized especially to manufacture for export. At the height of its prosperity it made only Y.100,000 profit and the highest dividend it paid was 10 per cent. At the end of October 1920 there was no dividend declared and since that time things have been getting worse.

The Nippon Kona Milk Co. began business in 1917. It earned profits of Y. 80,000 at the height of its prosperity and paid a dividend of 8 per cent. The special production of this company is powdered milk. This is now coming from England, and the Japanese manufacture simply cannot compete with it in quality nor in price. Since last year the industry has shrunk to nothing, and most companies have closed their factories. Other companies have amalgamated their interests, while others are having their business adjusted.

Proper Moves

The Boso Condensed Milk Co. has been amalgamated with the Tokyo Kashi Co., under the name of the Nihon Condensed Milk Co., with a capital of Y.300,000. The Tokyo Condensed Milk Co., with a capital of Y.50,000, was amalgamated with the Morinaga Candy Co. These amalgamations are all movements in the right direction, but there are still many small companies in the business, and they are much upset about their future in the face of these amalgamations of bigger interests. It is thought they should all amalgamate into one company, decrease their expenses and improve their product, as well as labor for an improvement of dairying conditions in Japan. The manufacturers themselves look at their future in somewhat this same light, but unfortunately not all of them can be made to see the light of reason, so they go on competing in a ruinous manner, and are thus hastening the complete destruction of their industry.

German Activity in the N.E.I.

THE Germans have been successful in gaining contracts for locomotives, rolling stock, electrical plant, water pipes and bridgework in the Dutch East Indies. Owing to the depreciation of the mark valuable orders have gone to Berlin, and further important contracts are likely to follow if Herr Stinnes succeeds in his schemes for the financial penetration of the islands.

In view, however, of the close watch that merchants and contractors in Holland are keeping on prospective business in the Dutch East Indies, it is probable that the conditions under which Herr Stinnes offers loans for purposes of development there will be scrutinized carefully before acceptance. It will be remembered that he offered to advance £10,000,000 gold on condition that the authorities placed their 1922 contracts with the Rhine Elbe Union. In financial circles it is now reported that the sum offered has been increased to £30,000,000 gold.

Another offer by Herr Stinnes was that of a loan of several million florins to the municipality of Bandoeng, the stipulation being made that all municipal works should be entrusted to the same combine. The manager of an eastern trading syndicate with headquarters at Hamburg, who was well known in Batavia both before and after the war, in a recently issued brochure throws doubt on the future of certain Dutch Indian industries which were started a few years ago.

The Stinnes group is by no means restricting its activities to the building or assembly of rolling stock and the supply of iron and steel and similar engineering accessories. Its representatives are closely following every possible development that would lead to a demand for machinery or material.

It is practically certain that they will seek to arrange for the local manufacture of textiles, but it is more than probable that many years would elapse before the establishment of cotton mills in Java would seriously affect Manchester's exports to Insulinde.

Yet it would surely be fitting, says *The Times* (London), for British enterprise and finance to be associated with the production of such manufactures. There is reason to believe that the Dutch East Indian government would offer advantageous conditions. Terms that have been suggested include the purchase by the state of the whole of the first year's output at cost price plus 12 per cent., one million yards of material during each of three succeeding years at 12 per cent. above competitive prices, one million yards for three further years at a 10 per cent. preference in price, etc. In the tenth year one million yards at competitive quotations. After the tenth year the factory would stand on its own footing.